INSTRUCTION MANUAL

S. Makanvand

INSTRUCTION MANUAL
FOR
SWEEP OSCILLATOR PLUG-IN
MODEL 6608EDA
Manual No. 1-500783-318
(For use with Serial No. 101 and above)

MP MASTER
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SINGER
INSTRUMENTATION

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The Model 6608EDA supersedes
Models 6607ED and 6608ED

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Figure 1-1. Model 6600 mainframe with Model 6608 EDA plug-in.

SECTION I
INTRODUCTION

1.1 SCOPE OF MANUAL

This manual provides operation and maintenance information for the Model 6608EDA Oscillator Plug-in unit that is for use with the Model 6600 Sweep Oscillator Mainframe. This manual should be used as a supplement to the basic Model 6600 instruction manual, No. 110-6020.

The Model 6608EDA instruction manual is divided into 10 sections: Introduction; Specifications; Operating Controls, Indicators and Receptacles; Installation; Operating Instructions; Theory of Operation; Minimum Performance Procedures; Maintenance; Replaceable Parts; and Schematics.

1.2 PURPOSE AND GENERAL DESCRIPTION

The Model 6608EDA is a plug-in RF head assembly designed to plug into a Model 6600 Mainframe to form an RF sweep oscillator. Hereafter in the Manual except in the Installation Section, the operational descriptions assume that the Model 6608EDA is installed in the Model 6600 Mainframe. Refer to Figure 1-1.

The frequency range of the Model 6608EDA can be electronically swept-tuned or manually tuned over the 10 MHz to 4.2 GHz frequency range in one continuous sweep. The sweep width and sweep rate can be independently adjusted by the operator. The plug-in unit is supplied with a linearly-calibrated frequency dial plate that is stored in a slot at the back of the unit. Installation of this plate onto the dial plate area of the Model 6600 calibrates the Model 6600 for operation with the plug-in unit.

The Model 6608EDA is equipped with an internal leveler-amplifier and internal RF sampler for self-contained leveling. The unit has front panel LEVELING switches for selecting internal (INT) leveling, leveling with external (EXT) sampling and unleveled (UNLEV) operation. The unit can be amplitude and frequency modulated by external modulating sources. Internal 1000 Hz square wave modulation and external pulse modulation, via the Model 6600, are provided. A network analyzer output, supplying a 0 to +42 volt ramp proportional to frequency, is included.

1.3 SUPPLIED ACCESSORIES

The items listed in Table 1-1 are furnished with the Model 6608 EDA Sweep Oscillator plug-in unit.

1.4 OTHER DOCUMENTATION FURNISHED WITH MANUAL

An envelope inside the back cover of this manual contains factory performance test data for the instrument as follows:

a. A document listing the instrument Model and Serial number and the particular values of the factory selected components used.

b. A maximum power output performance plot of the plug-in unit operated in the unleveled mode taken during final swept-frequency testing at Singer.

c. A maximum power output performance plot of the plug-in unit operated in the leveled mode taken during the final swept-frequency testing at Singer.

TABLE 1-1. SUPPLIED ACCESSORIES

Quantity	Item	Singer Part No.
1	Frequency Dial Faceplate	942407-53
1	Instruction Manual	1-500783-318

SECTION II
SPECIFICATIONS

2.1 GENERAL INFORMATION

This section contains specification information for the Model 6608EDA Sweep Oscillator plug-in unit, installed in a Model 6600 Mainframe.

2.2 SPECIFICATIONS

Table 2-1 contains specification data.

TABLE 2-1. SPECIFICATIONS

Characteristic	Specification Limits
FREQUENCY CHARACTERISTICS	
Frequency range: (continuous sweep)	0.01-4.2 GHz
Frequency accuracy: (CW mode, at 25°C)	
0.01-2.0 GHz	±(1% + 10 MHz)
2.0-4.2 GHz	±20 MHz
Frequency Stability:	
Change with temperature (0-50°C):	<250 kHz/°C
Change with line voltage ±10%:	<±20 kHz
Change with 10 dB power level change:	
0.01-2.0 GHz:	<1.5 MHz
2.0-4.2 GHz:	<250 kHz

(Continued next page)

(Table 2-1, continued)

Characteristic	Specification Limits
Change with 3:1 VSWR of load, all phases:	
0.01-2.0 GHz:	<1 MHz
2.0-4.2 GHz:	<100 kHz
Residual FM, CW mode: (BW 1 Hz-10 kHz)	<15 kHz peak-to-peak
Incidental FM with 30% AM at 1 kHz:	
0.01-2.0 GHz	<500 kHz
2.0-4.2 GHz	<50 kHz
Band switching:	
Switching point:	2.0 GHz ±40 MHz
Switching point overlap:	0 to 10 MHz, no hiatus
Switching hysteresis:	>20 MHz
RF POWER OUTPUT CHARACTERISTICS	
Leveled power output:	
At 25°C,	
0.01-4.0 GHz:	>10 mW
4.0-4.2 GHz:	>5 mW
0 to 50°C range,	
0.01-4.0 GHz	>9 mW
4.0-4.2 GHz	>4 mW
Leveled output control range:	>10 dB
Leveled output variation vs frequency:	
Internal leveling:	±0.5 dB
External leveling, excluding sampler:	±0.1 dB
Leveled output variation vs temperature: (0-50°C)	<1 dB
Source Impedance:	50 ohms nominal

(Continued next page)

(Table 2-1, continued)

Characteristics	Specification Limits
SPECTRAL PURITY	
Harmonics:	
Referred to +10 dBm output: (at 25°C)	>18 dB down
Non-harmonics:	
Referred to +10 dBm output:	>35 dB down
Broadband noise:	
Detector BW 1 Hz-10 kHz:	>45 dB down
Residual AM:	
Detector BW 1 Hz-10 kHz:	>50 dB down
RF output termination:	No spurious oscillations shall result from any termination.
MODULATION CHARACTERISTICS	
Internal square-wave modulation: (1 kHz from Model 6600)	
Rise time, 0.01-4.0 GHz	<5 μS
Fall time:	<1.0 μS
On/off ratio:	>40 dB
External pulse modulation: (AM, via Model 6600)	
Rise time:	
Leveled, 0.01-4.0 GHz:	<5 μS
Unleveled:	<3 μS
Sensitivity	0 V off, +5V on
Square Wave PRF:	DC-30 kHz
Symmetry:	40/60%
On/Off ratio:	>40 dB
Imput impedance:	10 kΩ nominal

(Continued next page)

(Table 2-1, concluded)

Characteristics	Specification Limits
External AM to Model 6608EDA (at 3 dBm output):	
Modulation factor:	> (0 to 50%)
Bandwidth, 3 dB:	DC to 20 kHz
Modulation Sensitivity:	10%/volt nominal
Input Impedance:	500 kΩ nominal
External FM to Model 6608EDA	
Deviation:	>±20 MHz
Bandwidth, 3 dB:	DC to 200 kHz
Modulation Sensitivity:	4 MHz/volt nominal
Input impedance:	10 kΩ nominal
OTHER CHARACTERISTICS	
Voltage proportional to frequency output:	
Output voltage open circuit:	10 volts/GHz ± (1% + 0.1 V)
Output resistance:	20 kΩ±1%
Dimensions:	Overall depth: 38.4 cm (15-1/8 inches) Overall depth behind panel: 36.8 cm (14-1/2 inches) Width: 17.8 cm (7 inches) Height: 7.8 cm (3-1/16 inches)
Weight:	3.12 kg (6 lbs., 14 oz.)
Power:	Provided by Model 6600
Temperature:	
Operational:	0°C to +50°C (+32°F to +123°F)
Non-operational:	-15°C to +75°C (+5°F to +167°F)

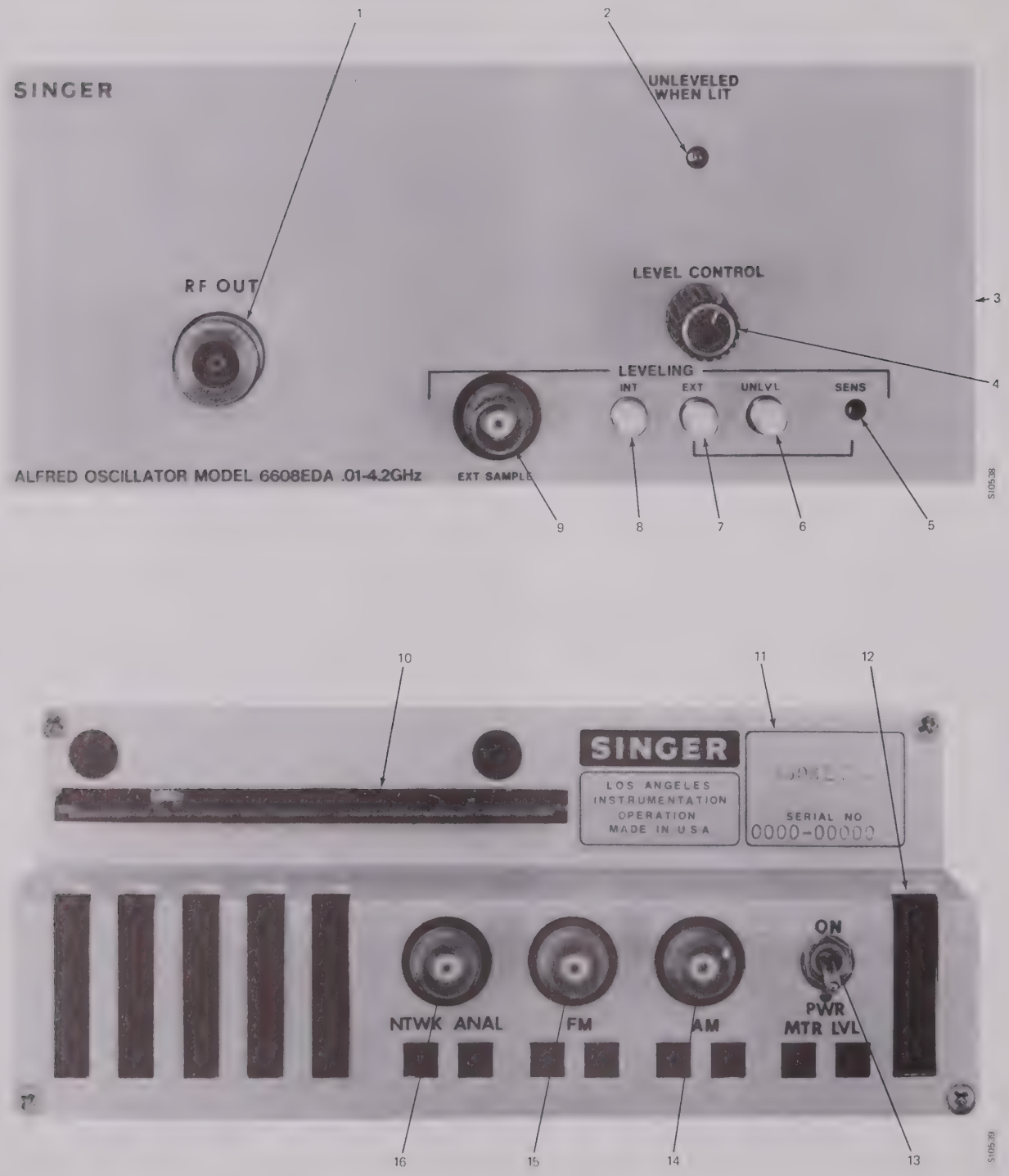


Figure 3-1. Operating Controls, Indicators, and Receptacles, Model 6608EDA.

SECTION III
CONTROLS, INDICATORS AND RECEPTACLES

3.1 INTRODUCTION

This section contains functional descriptions of all controls, indicators and receptacles for the Model 6608EDA sweep oscillator plug-in unit.

3.1.1 Controls, Indicators and Receptacles

All external controls, indicators and receptacles of the Model 6608EDA plug-in unit are located on the front and back panels, except for item 3, mounted on the right side, refer to Figure 3-1. The panel items are identified by number in Figure 3-1 and their function described in Table 3-1. Pin data information for multipin plug P1 is provided in Table 3-2.

TABLE 3-1. CONTROLS, INDICATORS AND RECEPTACLES, MODEL 6608EDA

Item	Panel Marking	Description	Function
1	RF OUT	Type N Female Receptacle (A2J1)	RF power output, 50 ohms impedance
2	UNLEVELED WHEN LIT	LED Indicator (A1CR55)	LED indicator lights when output signal is unleveled
3	EXT LEVELING + -	SLIDE SWITCH (A3S4)	Selects proper polarity circuit for positive or negative external sampler
4	LEVEL CONTROL	Potentiometer (A3R4)	RF level control, provides a range of at least 10 dB
5	SENS	Potentiometer (A3R3)	Gain control of amplifier for external sampler signal input. Is adjusted for best leveling.

(Continued next page)

(Table 3-1, concluded)

Item	Panel Marking	Description	Function
6	LEVELING UNLVL	Pushbutton switch (A3S3)	Unleveled operation selector pushbutton
7	LEVELING EXT	Pushbutton switch (A3S2)	Provides leveled operation from external signal sampler
8	LEVELING INT	Pushbutton switch (A3S1)	Provide leveled operation from internal signal sampler
9	EXT SAMPLE	BNC Receptacle (A3J2)	Input receptacle for external signal sampler
10		Plug, Circuit board (A1P1)	Plug, interconnect with Model 6600 Mainframe
11		Decal	Provides model and serial numbers
12		Slot	Frequency dial face plate storage slot
13	ON PWR MTR LVL	Toggle switch (A3S5)	Power meter leveling selector switch
14	AM	BNC Receptacle (A3J5)	External amplitude modulation input
15	FM	BNC Receptacle (A3J4)	External frequency modulation input
16	NTWK ANAL	BNC Receptacle (A3J3)	Output to network analyzer, voltage proportional to frequency

TABLE 3-2. A1 ASSEMBLY PLUG PIN DATA (P1)

Pin	Function
1	F3 input: ΔF or CW fine tuning voltages
2	F1 input: F1, M1 or F_o (CW) tuning voltage. F1 is start voltage for full band sweep, M1 is start voltage for marker sweep.
3	Mainframe reference ground.
4	Mainframe reference ground (same ground as pin 3)
5	Mainframe +20 volts input
6	Mainframe -20 volts input
7	Mainframe +10.5 volts input
8	Mainframe ground
9	Mainframe ground (same ground as pin 8)
10	Not used by Model 6608EDA, (Model 6600 pin function — "diode res")
11	+Program Resistor R69; sets +Program supply to +5V
12	Mainframe +62V input
13	Not used by Model 6608EDA (Model 6600 pin function - "-62V")
14	Not used by Model 6608EDA (Model 6600 pin function - "-diode")
15	-Program supply (-11V supply)
16	+Program supply (+5V supply)
17	Not used by Model 6608EDA (Model 6600 pin function - "band B")
18	Not used by Model 6608EDA (Model 6600 pin function - "RBE")
19	Not used by Model 6608EDA (Model 6600 pin function - "10 dB")
20	Not used by Model 6608EDA (Model 6600 pin function - "40 dB")
21	Mainframe RF marker
22	Mainframe RF AM out
23	NTWK ANAL circuit drive; main frame Voltage Proportional to Frequency
24	F2 input (F2 or M2 tuning voltages) F2 stop voltage for full band sweep, M2 stop voltages
25	Mainframe reference ground (same ground as Pin 3)
26	Mainframe reference ground (same ground as Pin 3)
27	Mainframe +20 volts input

(Continued next page)

(Table 3-2, concluded)

Pin	Function
28	Mainframe -20 volts input
29	Mainframe -10.5 volts input
30	Mainframe ground (same ground as Pin 8)
31	Not used by model 6608EDA (Mainframe RF ground)
32	-Prog. Res. (R70 sets - prog. supply to -11V)
33	CW filter relay control
34	Mainframe +62V input (same as Pin 12)
35	Not used by Model 6608EDA (Model 6600 pin function - "-62V")
36	Not used by Model 6608EDA (Model 6600 pin function - "diode")
37	-Prog. supply (-11V supply) (same as Pin 15)
38	+Prog. supply (+5V supply) (same as Pin 16)
39	Not used by Model 6608EDA (Model 6600 pin function - "band C")
40	Not used by Model 6608EDA (Model 6600 pin function - "band A")
41	Not used by Model 6608EDA (Model 6600 pin function - "RAE")
42	Not used by Model 6608EDA (Model 6600 pin function - "20 dB")
43	Ramp control (Sweep stop)
44	RF Blanking

SECTION IV
INSTALLATION INSTRUCTIONS

4.1 INTRODUCTION

This section of the manual contains instructions for preparing the sweep oscillator for operation.

4.2 EQUIPMENT SETUP

4.2.1 Installing into Model 6600 Mainframe

The Model 6600 Mainframe is not supplied with a frequency dial faceplate. The frequency faceplate for the Model 6608EDA Plug-in is stored in a slot on the back panel of the unit. Installation of this plate onto the dial plate area of the Model 6600 calibrates the Model 6600 for operation with the Model 6608EDA. Remove the frequency faceplate from the slot and insert it into the Model 6600 as follows:

a. Place the beveled edge at the left end of the frequency faceplate under the lip of the left end of the Model 6600 frequency dial. The corresponding lip of the right end of the Model 6600 frequency dial is spring loaded. Slide it about 1/4 inch to the right, and place the frequency faceplate in position over the frequency dial. Two plastic pins are spring loaded to force the plate out for removal. Push them flush with the dial, when mounting it.

b. Release the sliding lip and check that the frequency faceplate is secure. There is a calibration line on the frequency faceplate. This should coincide with two dots on the Model 6600 frequency dial. If it does not, adjust its position by turning the screw-head at left center of the frequency faceplate.

Push the Model 6608EDA Plug-in into the Model 6600 front panel plug-in opening until the black lever is forced down, then up a little. Continue by pushing the black lever up until almost flush with the panel. The

Model 6600 and the Model 6608EDA panels should be flush. Several pounds force may be required to push the lever in.

4.2.2 Power Requirements

The Model 6608EDA is powered from the Model 6600 Mainframe. Therefore, only the mainframe has a primary power cord. The Model 6600 is normally connected at the factory for operation at 115 Vac nominal. Check the position of the slide switch under the plastic protective cover next to the power cord terminals to see that the switch is set to 115 V. If the operation must be changed to 230 V, remove the power cord, slide the plastic protective cover to the left to expose the fuse, remove the fuse and set the slide switch to the 230 V position. Insert a new fuse and slide the plastic cover back.

NOTE

For 115 Vac, use a 1.6A slow blowing fuse
For 230 Vac, use a 0.8A slow blowing fuse

To reconvert for 115 Vac operation, reverse the above procedure.

4.2.3 To Energize Equipment

a. Plug the Model 6600 power cord 3 prong plug into the ac power source.

b. Depress the POWER pushbutton on the Mainframe to turn on. (Release the POWER pushbutton to turn off).

c. The instrument is ready for use immediately after turn on. However, some of the precise frequency accuracy specifications are only met after a 30-minute warm-up period.

Section V
OPERATING INSTRUCTIONS

5.1 INTRODUCTION

Instructions for operating the Model 6608EDA Oscillator Plug-in in conjunction with Model 6600 Mainframe are presented in this section. Refer to Section IV for instructions for installing the Model 6608EDA Plug-in unit into the Model 6600 Mainframe. Refer to Section III for descriptions of Model 6608EDA operating controls, indicators and receptacles. For detailed information about the operation of the Model 6600 Mainframe, refer to its instruction manual.

5.2 OPERATING INSTRUCTIONS

5.2.1 AC Power

The Model 6608EDA is powered from the Model 6600 Mainframe. Depress the POWER pushbutton on the Mainframe to turn on.

5.2.2 CW Operation

For CW operation, no external signal is to be applied to the FM or AM jacks located on the rear panel of the 6608EDA. Set the front panel LEVELING to the desired leveling manner and the LEVEL CONTROL to the desired power output. On the Model 6600 Mainframe, press the CW pushbutton switch and tune the Fo control to the desired output frequency, as read on the upper scale of the frequency dial.

5.2.3 CW FINE Operation

For precise tuning of a single frequency, there is an Fo FINE frequency adjustment. This Fo FINE control is used with the calibrated vernier Fo FINE

scale located on the lower right side of the frequency dial. On the Model 6600 Mainframe, press the CW FINE pushbutton; the Fo FINE tuning control is now an extension of the Fo control, that is, it is a vernier frequency adjustment whereas Fo provides a coarse adjustment. The Fo FINE control has a range of 0 to ±5 percent of the tuning range of the frequency band covered, i. e., ±0. 05 (4200-10 MHz) or approximately ±210 MHz.

5. 2. 4 Swept Frequency Modes

There are three recurring sweep modes available in the Model 6600/6608EDA: Full Band, Marker Sweep, and ΔF Narrow Band Sweep.

a. Full Band Operation – In Full Band sweep mode, the Model 6600/6608EDA sweeps across the entire 0. 01-4. 2 GHz frequency range. The sweep is in the direction of increasing frequency. If RF MARKER mode was selected, all three markers (M1, Fo and M2) will be present at the RF output of the Model 6608EDA. Full Band sweep is convenient for quick testing over the entire band.

   For Full Band sweep, press the FULL BAND pushbutton. If RF signal is to be off during the sweep retrace, also press the RF BLANKING pushbutton. Select the desired sweep rate by depressing the corresponding SWEEP TIME (SEC) pushbutton. Set VARIABLE sweep time control to CAL position to obtain a sweep time that is exactly equal to the pushbutton selected time. If the variable control is turned fully clockwise, the switch-selected value is expanded by a factor of 10.

   Press the desired TRIGGER mode pushbutton. When a continually recurring sweep is desired, the INT triggering mode would usually be selected.

   If frequency markers are desired, press the MARKER pushbutton. Set the M1and M2 controls to the desired frequencies as read on the upper scale of the frequency dial. Adjust marker amplitude using the MARKER AMPL control.

b. Marker Sweep Operation – Marker sweep mode is similar to the Full Band sweep mode, but is used for testing over narrower portions of the band. In marker sweep the Model 6600/6608EDA sweeps between the frequencies to which markers M1 and M2 are set. Sweep start and stop frequencies can be set anywhere within the 0. 01-4. 2 GHz band, for either a frequency upsweep or a downsweep. The sweep always starts at M1 and stops at M2.

   For marker sweep, set markers M1 and M2 to the desired start and stop frequencies. For downsweep, set M1 above the frequency of M2. Press the M1 → M2 pushbutton to enable the Marker Sweep mode.

Set the sweep time, blanking, and trigger controls for convenience, as in Full Band sweep above.

Only the Fo marker is available in Marker Sweep mode. To activate the marker, press the RF MARKER pushbutton and adjust MARKER AMPL to a desired marker amplitude. To disable the Fo marker, turn MARKER AMPL to OFF or press RF MARKER pushbutton off.

c. ΔF Narrow Band Sweep Operation. The ΔF sweep mode is a narrow-band sweep that is symmetrical about a center frequency, Fo. The ΔF sweep extends approximately ±400 MHz about Fo, as read on the ΔF scale. Maximum sweep width is thus approximately 800 MHz. The Fo and ΔF controls operate independently of one another and can be reset during narrow-band operation to change the desired Fo center frequency or change the ΔF bandwidth.

To place the sweeper in narrow-band sweep mode, press the $\frac{Fo}{\Delta F}$ pushbutton. Adjust ΔF control to the desired sweep width, in MHz, as read on the lower, left-hand ΔF scale. To center this ΔF window on any frequency, tune the Fo control to the frequency of interest, as read on the upper scale of the frequency dial.

5.2.5 Manual Sweep Operation

In Manual Sweep, the RF output frequency can be swept (or tuned) over all or any portion of the 0.01-4.2 GHz frequency range of the Model 6608EDA plug-in, as determined by the Model 6600 frequency controls and the sweep mode selected: Full Band, Marker or ΔF mode. Output frequency is manually controlled by the MANUAL SWEEP knob. Frequency can be tuned in either direction, at any desired rate, between the band limits set by the selected sweep mode controls. Markers do appear, if selected. Leveling is available, as for normal sweeping operation.

Pulling the MANUAL SWEEP knob will stop the automatic frequency sweep-retrace motion. The Model 6608EDA can then be swept (or tuned) across the set band limits by rotating the MANUAL SWEEP knob from end to end.

5.2.6 Leveling

Three RF output leveling modes can be selected on the front panel of the Model 6608EDA – unleveled, internal and external.

a. For unleveled mode of operation, press the UNLVL pushbutton. This disables the leveling loop and makes the RF output level solely dependent upon the setting of the LEVEL CONTROL and the characteristics of the sweeper's RF components. The output power will vary greatly with frequency.

b. For internally leveled mode of operation, press the INT pushbutton. This enables the internal sampler and leveling loop. The RF output power will exhibit little change over the 0.01-4.2 GHz frequency range but will be lower than in the unleveled mode.

c. For externally leveled mode of operation, press the EXT pushbutton. In this mode, the RF output power is controlled using an external sampler. The sampler consists of a directional coupler and crystal detector; these are used to detect the RF signal level at some remote point in the RF transmission line. The detected signal is fed, via the EXT SAMPLE jack, to the leveling loop of the Model 6608EDA thus producing leveling at that remote point.

   When using an external sampler, the polarity of the detector's output has to be ascertained. The "EXT LEVELING + -" switch, located on the right side panel of the Model 6608EDA plug-in, has to be set for the proper operation of external leveling; the switch selects internal circuits for either positive or negative external sampler polarity. The gain of the leveling loop must be adjusted for best leveling. This is done with the SENS screwdriver adjustment located on the front panel. Too much gain will cause oscillations in the leveling loop while insufficient gain will result in poor leveling.

5.2.7 Amplitude Modulation

To amplitude-modulate the Model 6608EDA RF output, connect an external modulating signal to the AM jack located on rear panel of the Model 6608EDA plug-in. The RF output is then AM modulated and the relationship between the modulating voltage and the output power is linear. The AM jack is dc coupled, and the applied signal amplitude should not exceed ±6 volts peak. The AM circuit will modulate to a frequency of over 20 kHz.

The modulation sensitivity of the Model 6608EDA plug-in is 10 percent per volt; modulation of 50 percent or more can be realized. A positive input provides an up modulation. To be able to up modulate, the RF level must be below its maximum by the amount of up modulation.

5.2.8 1 kHz Square-Wave Modulation

The Model 6600 Mainframe contains an internal 1 kHz square-wave generator. To square-wave modulate the RF output of the Model 6608EDA plug-in, set the Mainframe rear panel AM MODE switch to INT SQ WAVE position; on the front panel, press the RF AM pushbutton. Using the rear panel "1 kHz ADJ" control the modulation frequency may be fine tuned between 950 and 1050 Hz.

5.2.9 Frequency Modulation

To frequency modulate the RF output of the Model 6608EDA plug-in connect an external modulating signal to the FM jack, located on rear panel of the Model 6608EDA. The amplitude of the applied signal should not exceed ±6 volts peak. The FM jack is dc coupled and will accept modulating signals ranging from dc to over 200 kHz. A positive-going applied dc signal will produce an increase in RF output frequency. The nominal FM sensitivity is 4 MHz/volt, and FM deviation over ±20 MHz is attainable.

5.2.10 Pulse Modulation

To pulse modulate the Model 6608EDA RF output, connect the external pulse modulating signal to the ON/OFF PM IN jack located at rear of the Model 6600 Mainframe, and set the AM MODE toggle switch to the external position. On the Model 6600 front panel, press the AM pushbutton. To turn the RF on, the positive excursion of the input signal should be between +4.5 and +5.0 volts; the RF is turned off by 0 volts.

CAUTION

The applied signal must not exceed +5 volts — excessive voltage may damage the Model 6600 Mainframe.

5.2.11 RF OFF Switching

The Model 6600/6608EDA sweeper has no direct provisions for RF OFF (stand by) control. However, RF on-off switching can be performed from the front panel of the instrument. Connect a BNC shorting plug to the

ON/OFF PM IN jack located on the rear panel of the mainframe, and set the AM MODE toggle switch to external position. With this hook-up, the RF is gated off by over 40 dB whenever the RF AM pushbutton is pressed on the front panel.

5.2.12 Power Meter Leveling

Power meter leveling is an external leveling method, using the power meter as the external detector. The Model 6608EDA can be leveled by power meters providing a positive output voltage, such as the Hewlett-Packard Models 432A and 435A. The Recorder Output of the power meter is attenuated and fed to the EXT SAMPLE jack located on the front panel of the Model 6608EDA.

Inasmuch as the Recorder Output signal level from the power meter is too high for the leveling loop of the Model 6608EDA plug-in, an attenuator has to be installed between the two instruments. A series resistor of 100 kΩ to 1 MΩ or a 6 dB to 10 dB 50 Ω coaxial attenuator should be connected at the input EXT SAMPLE jack of the plug-in. Set the Model 6608EDA "EXT LEVELING + -" side panel switch to + position and turn on the PWR MTR LVL switch located on the rear panel. To optimize the leveling, the SENS screwdriver adjustment on the front panel may require adjusting. See Paragraph 5.2.6.

Power meters have a relatively slow response to changing signal levels. The sweep rate of the Model 6600/6608EDA sweeper must be reduced sufficiently to allow time for the power meter to respond; press the 10 SEC pushbutton of the SWEEP TIME, and vary the sweep VARIABLE control as required to achieve leveling tracking between the instruments. When using an extremely slow power meter, such as Hewlett-Packard model 435A, the leveling loop response of the Model 6608EDA has to be slowed additionally. This is accomplished by making a modification to the internal circuitry of the Model 6608EDA. Remove the plug-in from the mainframe and remove the top cover. Install a short wire jumper on the printed wiring board at location marked "W4," then re-install the cover and plug the unit into the mainframe.

5.2.13 NETWORK ANALYZER Output

The Model 6608EDA plug-in provides an output voltage ramp for synchronizing external test equipment such as network analyzers. The voltage at the NTWK ANAL jack is proportional to the output frequency and varies at the rate of 10 volts/GHz, for a total range of +0.1 to +42.0 volts. This signal is available from the rear panel NTWK ANAL jack of the Model 6608EDA plug-in.

Section VI
THEORY OF OPERATION

6.1 INTRODUCTION

This section contains the theory of operation of the Model 6608EDA Sweep Oscillator plug-in. The information is presented twice: a basic discussion of the Block Diagram, Figure 6-1, starting with Paragraph 6.2; and a more detailed presentation based on Schematic Diagrams, Figures 10-1 through 10-3, starting with Paragraph 6-3.

6.2 BASIC THEORY OF OPERATION

The Model 6608EDA plug-in contains the RF circuits, their control logic, modulation sections, and a leveling loop. These are shown in the system block diagram, Figure 6-1.

6.2.1 RF Generation

The 2-4.2 GHz YIG oscillator (YIG OSC) is the main RF power generating device. It supplies the RF output power from 2.0 to 4.2 GHz through the ISOLATOR, 4-PORT PIN SW/LEVELER and SAMPLER for high band (2.0 - 4.2 GHz) operation.

Low band (0.01 - 2.0 GHz) operation uses a heterodyne scheme. A fixed frequency 2.2 GHz OSC is mixed with the variable frequency YIG OSC in the MIXER. Their difference frequency is amplified in the WIDE BAND AMP. A 3 GHz LPF and a 2 GHz LPF are filters used to remove undesired frequencies from the heterodyne system. The WIDE BAND AMP supplies the RF output power for the low band through the 4-PORT PIN SW/LEVELER and SAMPLER.

The YIG OSC transistor uses two voltage regulators. One is a fixed +15 V YIG SUPPLY; the other is the Vc YIG SUPPLY, a ramp voltage that changes its voltage with the YIG OSC frequency. Vc may not be required by some oscillators.

The TEMP COMP circuit corrects the YIG OSC frequency for temperature changes.

6.2.2 Frequency Control

Three ramps, F1, F2 and F3 from the Model 6600 Mainframe are the frequency controlling signals. The RAMP ADDER combines the three ramps and feeds them through the BAND END ADJUSTMENTS to the YIG TUNING DRIVER. The YIG TUNING DRIVER supplies the tuning current to the YIG oscillator.

6.2.3 Band Switching

Band switching occurs at a predetermined voltage on the Model 6600 ramp. When this voltage is reached, the BAND SELECT COMPARATOR will change state, changing the BAND SELECT LOGIC. The BAND SELECT LOGIC changes the BAND SELECT GATES, the BAND END ADJUSTMENTS and the BAND SELECT and MODULATION GATE LOGIC. The BAND SELECT GATES control the LOW and HIGH BAND PIN DRIVERs. The BAND END ADJUSTMENTS control the frequency limits of the YIG OSC. The BAND SELECT & MODULATION GATE LOGIC controls the BAND SELECT DRIVER, controlling the 4-PORT PIN SW/LEVELER band switching.

The DUAL DIRECTION SWEEP STOP SENSING detects band change in either direction. Its output is combined with RF blanking from the Model 6600 Mainframe to control the 2 ms and 6 ms SWEEP STOP TIMING. The SWEEP STOP LOGIC selects the proper sweep stop time to be used by the Model 6600 Mainframe during band change.

6.2.4 Leveling

The SAMPLER detects the RF output power level and produces a feedback signal which is used to "level" the RF output power. The SAMPLER feedback signal is fed through the INT SAMPLER BUFFER to the SAMPLER

SELECT GATES. The SAMPLER SELECT GATES select positive or negative polarity external sampler signals, or the internal SAMPLER signal. The signal then goes to the LEVEL LOOP AMP. The LEVEL LOOP AMP drives the LOW BAND PIN DRIVER and HIGH BAND PIN DRIVER.

The BAND SELECT GATES control which PIN driver receives the leveling loop signal. The LOW BAND PIN DRIVER controls the 2.2 GHz OSC level through the 2.2 GHz PIN SW, thus controlling the RF output power in the low band. The HIGH BAND PIN DRIVER controls parts of the 4-PORT PIN SW/LEVELER, controlling the RF output power in the high band. The 4-PORT PIN SW/LEVELER also switches RF signals, producing the band switching in the heterodyne section.

The INT SAMPLER SLOPE ADJUST corrects for a sloping RF power output with internal leveling.

6.2.5 Output Controlling

The front panel LEVEL CONTROL adjusts dc to the LEVEL LOOP ADDER, thus controlling the dc in the LEVEL LOOP AMP or the UNLEVEL CONTROL AMP. This dc from the selected amplifier adjusts the RF output power level.

The LEVEL LOOP ADDER is also the input for AM modulation or markers from the Model 6600. The input for AM pulse modulation is into the BAND SELECT & MODULATION GATE LOGIC, thus controlling the MODULATION GATE, LOW & HIGH BAND PIN DRIVERS, and BAND SELECT driver.

The UNLEVEL SENSING will turn on the unleveled indicator any time the leveling loop is not leveling.

The POWER METER LEVEL LOGIC controls the change of roll off frequency of the leveling loop while externally leveling with a power meter.

The FM AMP DRIVER drives the YIG OSC FM coil to frequency modulate the YIG OSC.

The VPF AMP takes the VPF from the Model 6600 and produces a voltage proportional to frequency output.

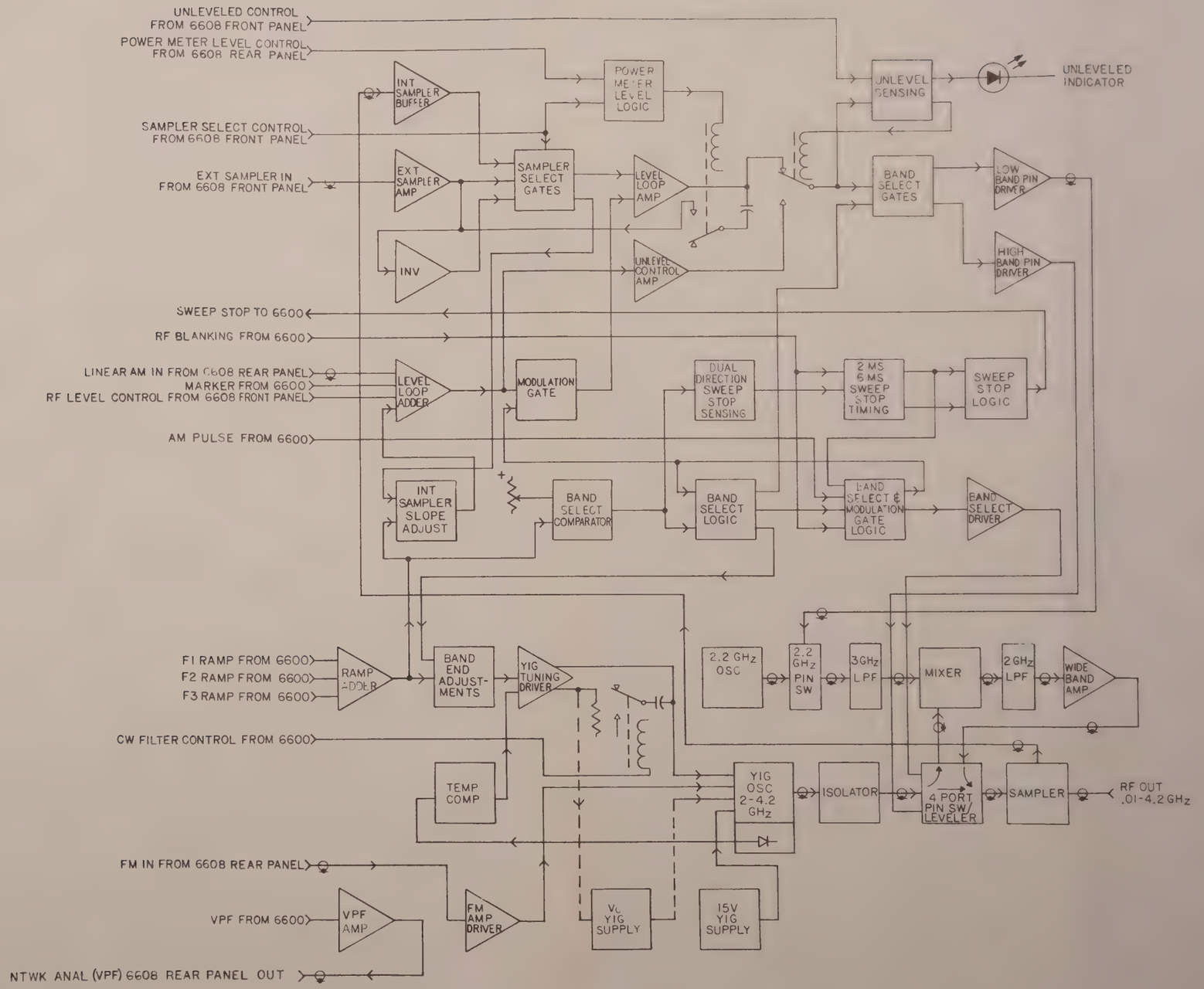


Figure 6-1. System block diagram Model 6608EDA.

6.3 DETAILED THEORY OF OPERATION

6.3.1 Introduction

The Model 6608EDA plug-in oscillator unit is used with the Model 6600 Sweep Oscillator Mainframe. The plug-in's frequency coverage is from 0.01 GHz to 4.2 GHz. This frequency range is available in both swept as well as CW mode. The Model 6608EDA plug-in covers the 0.01-4.2 GHz frequency range in two sequentially-tuned oscillator circuits. The low-band circuit generates the 0.01-2.0 GHz frequencies and the high band circuit the 2.0-4.2 GHz frequencies. The outputs of the two circuits appear sequentially at common front panel output port J1.

6.3.2 RF Circuits

The RF signal flow through the Model 6608EDA plug-in is described below. Refer to schematic diagram Figure 10-2. The low-band RF output is generated by mixing a 2.2 GHz fixed-frequency signal from oscillator Y2 with 2.21-4.2 GHz signals obtained from oscillator Y1.

Y1 is a solid-state YIG-tuned oscillator. It generates a sweeping, high-level (over 50 mW) RF signal. It contains a transistor oscillator whose output frequency is varied by changing the oscillator's tuning current. The changing dc current changes the magnetic field intensity generated by the tuning coil. The changing magnetic field will change the resonant frequency of the YIG sphere, thereby changing the oscillator's output frequency.

The RF from Y1 is fed through isolator AT1 to connector J1 of 4-port switch S1. Ferrite isolator AT1 serves to reduce the pulling effects of load variations on the YIG oscillator's frequency and power output.

The 4-port PIN switch-leveler S1 switches the RF signal from Y1 in the proper manner to produce the two bands. In the low-band mode, the switch directs the RF signal to the heterodyne circuit. The RF signal leaves through J3 of the switch, passes through 3 dB attenuator AT3 and enters the LO port of mixer Z1. Attenuator AT3 helps stabilize the mixer characteristics as well as set the local oscillator level required by the mixer.

The 2.2 GHz oscillator Y2 is a solid-state oscillator used to generate the second, lower-level RF signal required by the heterodyne circuit. The oscillator's output signal is fed through 20 dB attenuator AT2. Attenuator AT2 serves to isolate the oscillator output circuit from load variations caused by switch S2. AT2 also sets the RF level required for the level control action of switch S2.

Switch S2 is a PIN diode attenuator. In the high-band mode, S2 acts as a high-loss attenuator, in effect cutting off the 2.2 GHz RF signal to mixer Z1. In the low-band mode, S2 acts as a variable attenuator that adjusts the level of the 2.2 GHz signal that is delivered, through filter FL1, to the mixer's RF port. A detailed description of S2 is given in paragraph 6.3.5. The 3 GHz low pass filter FL1 is used to prevent harmonics of the 2.2 GHz signal from entering the mixer.

Mixer Z1 is a doubly balanced type mixer. Due to the properties of its balanced configuration, the LO and RF input signals are cancelled internally and do not appear at the mixer's output. The output thus consists only of the sum and difference frequencies of the two input signals.

Attenuator AT4 couples the heterodyne signals from the mixer to filter FL2. Attenuator AT4 helps isolate the mixer from its load. The 2 GHz low pass filter removes the undesired mixer outputs above 2 GHz. Attenuator AT5 improves the impedance match between filter FL2 and the wide-band amplifier.

The amplifier consists of pre-amplifier AR1 and power amplifier AR2. Amplifiers AR1 and AR2 are a matched set, providing a uniform 42 dB gain over the 0.01-2.0 GHz low band frequency range. The AR1-AR2 amplifier set amplifies the difference heterodyne signal to the level required at the plug-in's RF output.

The amplified low-band signal flows back through the J4-J2 path of 4-port switch S1 to sampler HY1. The sampler monitors the RF output level and supplies a negative-polarity dc signal to the leveling loop. The signal amplitude is proportional to the level of the RF output signal.

In the high-band mode, the YIG oscillator Y1 is tuned over the 2.0-4.2 GHz frequency range. The oscillator's output is fed through isolator AT1 to switch S1. The signal flows through the J1-J2 path of the switch.

This section of the switch also operates as a variable attenuator. The amount of attenuation is a function of the dc bias applied to the PIN diodes by the leveling loop. A detailed description of switch S1 is given in paragraph 6.3.5. The high-band RF signal then proceeds through sampler HY1 to the output port of the Model 6608EDA plug-in.

6.3.3 DC Voltages

The Model 6600 Mainframe contains all the power supplies and many of the control circuits required to operate the Model 6608EDA plug-in. These voltages and signals are supplied to the plug-in through its terminal strip P1, which is part of master board A1. Schematic diagram Figure 10-1 shows the interconnection between the Model 6600 Mainframe and Model 6608EDA plug-in. The Model 6600 Mainframe voltages and their uses are listed below:

+20 V	main positive supply
+ 5 V (+ prog)	logic supply voltage
-11 V (- prog)	main negative supply
-20 V	YIG tuning coil
+62 V	VPF amplifier
+10.5 V	positive reference voltage
-10.5 V	negative reference voltage

Two grounding systems are used in the Model 6608EDA plug-in, a reference ground and a chassis ground. The reference ground is a low-current signal ground, used as the return of the sensitive frequency-control voltages. It keeps other, high-level ground currents out of the frequency controlling section. The reference ground is floating in the Model 6608EDA plug-in; its actual ground connection is in the Model 6600 Mainframe. The chassis ground is a high-current ground for the remaining circuits of the Model 6608EDA plug-in.

Chokes L1 through L13 reduce the cross-coupling of the various power supply voltages and branches on the master board. Zener diodes CR18 through CR21 provide over-voltage protection to the Model 6608EDA plug-in. Resistor R69 establishes the + Program voltage supplied from the

Model 6600 Mainframe at +5 volts. Resistor R70 establishes the - Program voltage supplied from the Model 6600 Mainframe at -11 volts.

6.3.4 YIG Control Circuits

All the electrical control circuits of the Model 6608EDA plug-in are located on the master board A1. The signal flow between the various circuits is shown in block diagram Figure 6-1, and circuitry details are shown in schematic diagram Figures 10-1 and 10-2.

Three ramp voltages, F1, F2, and F3, are supplied from the Model 6600 Mainframe. All three ramp voltages are used for controlling the Model 6608EDA output frequency. F1 is connected to U2, a non-inverting unity gain amplifier. F3 is connected to U1, also a non-inverting unity gain amplifier. F2 is mixed with the outputs of U1 and U2 at the input of U3, a non-inverting amplifier. The ramped output of U3 is equal to F1 + F2 + 0.1 F3. This ramp voltage is 0.0V to +10.0V, and corresponds to a linear frequency change from 0.01 GHz to 4.2 GHz. The ramp voltage may be monitored at test point TP1. See Figures 6-2a and 6-3a. Diodes CR1 and CR2 clamp the output of U3 at -0.7V and +10.7V, to limit the voltages applied to the YIG driver.

YIG tuning band select gates Q1-Q4, Q6 and Q7, are turned on by saturation of transistors Q8 and Q9. This removes the positive bias from the FET's, the bias being supplied from the +20V supply via resistors R43, R44 and diodes CR3-CR8. With the positive bias removed, the FET becomes a short circuit for the ramp or offset current. The output of U3 supplies the ramp, via the band select gates Q1 and Q2, to the calibration resistors. Resistors R12 and R13 are for setting the YIG oscillator's frequency limits for the low-band mode. Resistors R13 and R14 are for setting the high-band mode. This ramp determines the change of current in U5.

An offset current, from the +0.5V supply via gates Q3 and Q4, is supplied for each band to U5. The offset current for the low band is determined by calibration resistors R37, R38, and R39. For the high band, the offset current is determined by resistors R39, R40, and R41. A third input to U5 is a fixed current from the -10.5V supply via R16. This fixed current is supplied to U5 so that the ramp and offset currents will have a practical range.

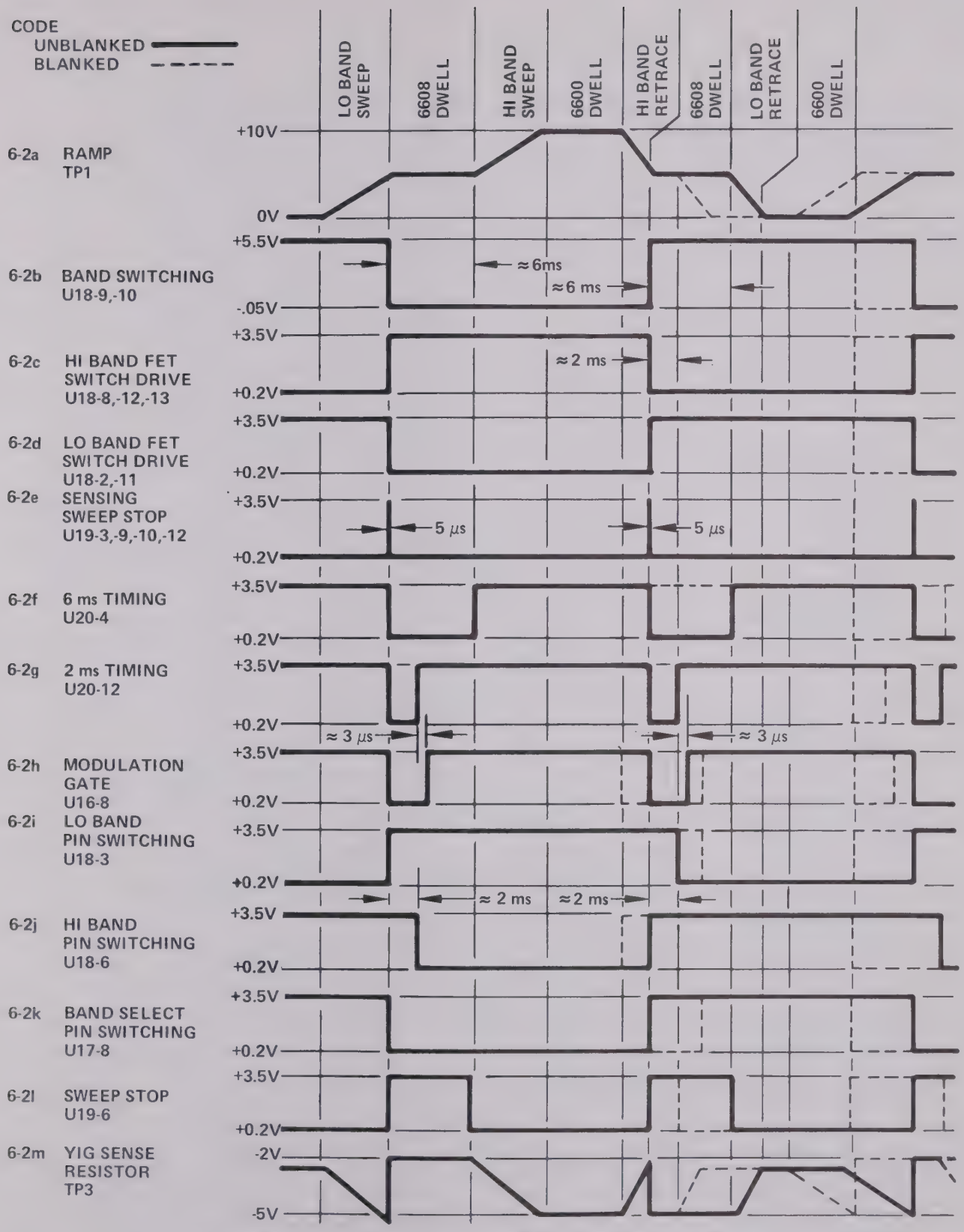


Figure 6-2. Timing Diagrams – Full Band Sweep.

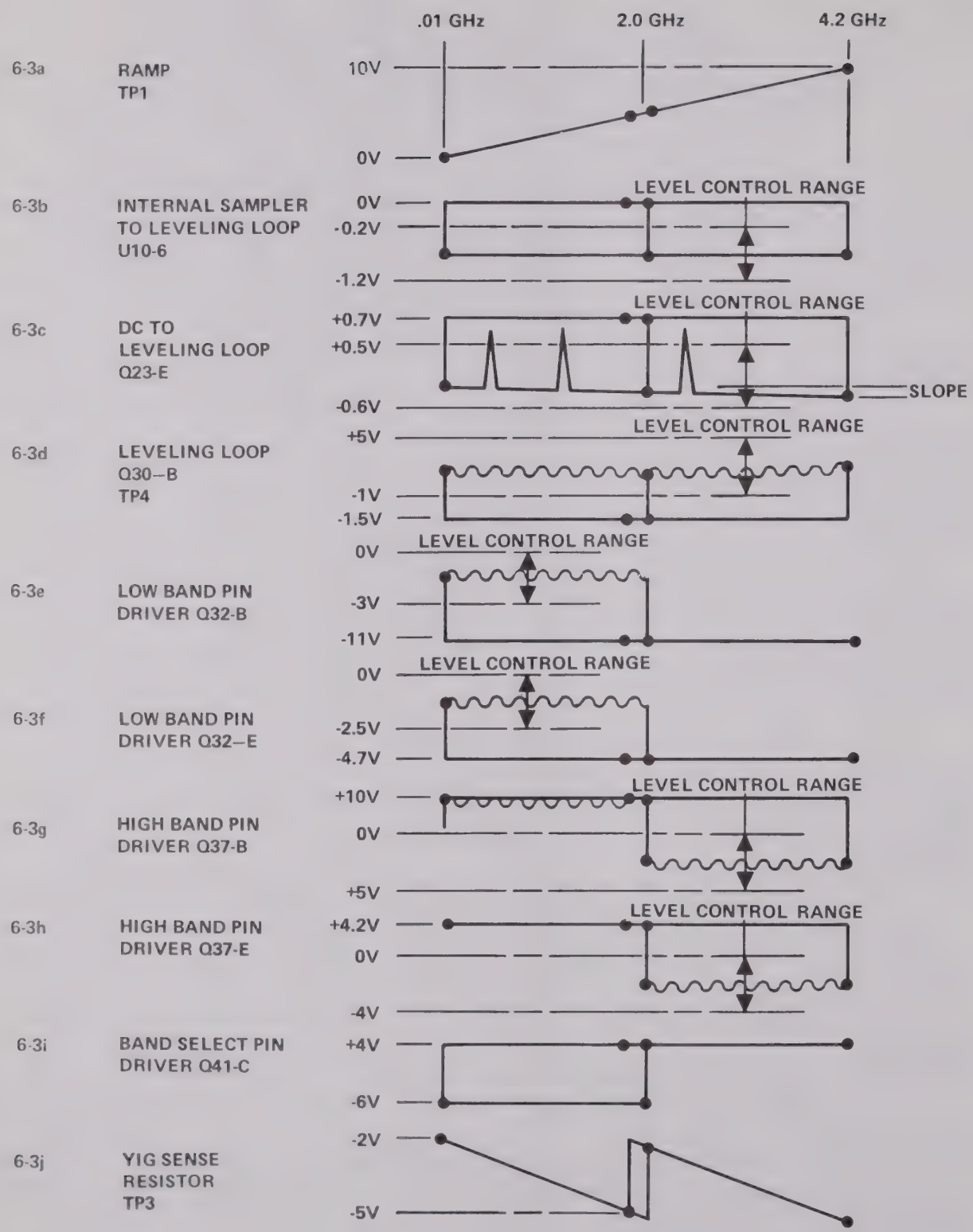


Figure 6-3. Leveling and dc Waveforms for Internal Leveling W/Blanking.

The settings of the four variable calibration resistors, R12, R14, R37 and R41, determine the YIG oscillator sweep limits for the low and high-band modes. The controlling function of each resistor is:

R12	low band, high end
R14	high band, high end
R37	low band, low end
R41	high band, low end

A small current from the YIG oscillator temperature compensation circuit is also added to U5. This current helps maintain a constant output frequency during temperature fluctuations. Resistors R28, R29 and R30, and diode A2CR1 form the bridge that is used to sense the temperature of the YIG oscillator. The diode A2CR1 is physically bonded to the oscillator's body, thus being in thermal contact with it. The diode is one of the lower legs of the bridge and potentiometer R30 is the other lower leg, and both are returned to the reference ground. The two fixed resistors from the upper legs of the bridge are connected to the +10.5V reference voltage. The output taken across the bridge is connected to U4 by jumper wires W1 and W2. Wires W1 and W2 can be connected so that U4 can be changing in either a positive or negative direction with respect to the temperature drift sensed by the bridge. The current flowing through the bridge developes a fixed voltage across the wiper of potentiometer R30 while developing a variable voltage across the diode. The resistance of the diode's internal junction is an inverse function of the temperature; as the function temperature increases, the resistance decreases. The voltage that is developed across the diode will, therefore, decrease as the oscillator's temperature increases.

The drift direction of a YIG oscillator or RF section can be either positive or negative with respect to the ambient temperature of a system. Wires W1 and W2 can, therefore, be installed to compensate for drift in either direction. If, for example, an increasing frequency drift is measured for a particular plug-in unit, the wires are connected in the positive direction position. This connects A2CR1 to the positive input of U4. Since the diode has a negative slope with respect to temperature, the output of U4 will be a negative going voltage with increasing temperature. The current supplied by

U4 to U5 will then reduce the total current into U5 and this will cause the YIG frequency to be tuned downward with increasing temperature. Potentiometer R34 controls the amount of temperature compensation current. R30 sets the offset to U4 close to zero for a warmed-up YIG oscillator. Op amp U4 has a gain of 21.

Op amp U5 and transistor Q5 are the YIG oscillator tuning coil drivers, with Q5 being a high-current Darlington amplifier driven by U5. The tuning current flows through the YIG oscillators tuning coil, transistor Q5, and current-sensing resistor R18. The tuning current (voltage across R18) may be monitored at TP3. See Figures 6-2m and 6-3j. The voltage across R18 produces the feedback around U5 and Q5. The feedback sets the current gain of U5 and Q5 at 400.

The input currents supplied to U5 are returned to reference ground. The output of U5 drives Q5. The current in Q5 is large and must be separated from the reference ground. Thus U5 is involved with both grounding systems. To maintain a separation of grounds, and to balance the impedance at U5 inputs, the second input of U5 must be returned to both grounds. Resistor R21, which is equal in value to R17, provides the normal current ground for U5. Resistors R22 and R24 provide the reference ground returns for low-band operation, and the R22-R25 combination is the reference ground return for the high band. Gates Q6 and Q7 are used to switch these ground return resistors for band changes.

Transistor Q5 drives the tuning coil of the YIG oscillator. A positive going current into U5 produces a negative going current in the tuning coil. Fuse F3 protects the tuning coil and Q5 from excessive current. Diodes CR11 and CR12 protect the tuning coil from excessive forward voltage, while diodes CR9 and CR10 protect against excessive reverse voltage during retrace. R19 and C7 provides frequency correction during retrace.

When the CW sweep mode is selected on the front panel of the 6600 mainframe, the 6600 circuits will energize relay K1. Relay K1 connects the CW filter across the tuning coil of the YIG oscillator. The CW filter, consisting of capacitors C9, C10, C11 and C12, removes any short-term noise and fluctuations from the tuning current. The resulting constant tuning current will provide a stable fixed output frequency.

The YIG oscillator contains a heater. The heater maintains the YIG sphere at a near constant temperature, thereby reducing frequency drift and stabilizing other characteristics. The heater is operated from the +20V supply.

The microwave transistor circuit of the YIG oscillator requires a dc voltage of +15V. This voltage is derived from the +20V supply via U7 and Q12. U7 and Q12 serve as the YIG voltage regulator circuit. R60 sets the reference current from the -10.5V reference voltage. R200 establishes the feedback current. The ratio of R60 to R200 determines the regulated output voltage with respect to -10.5 volts. Fuse F1 protects the YIG transistor oscillator against excessive current while diode CR16 protects from excessive voltage. Some types of YIG oscillators require an additional dc voltage for their operation. This second voltage is a positively sloped, ramped control voltage whose magnitude is a function of the desired output frequency. Op amp U8 and transistor Q13 generate the ramped control voltage. The YIG tuning-current ramp is sensed at R18, the YIG sense registor. R61 sets the reference current from the -10.5V supply. R66 sets the feedback current while R65 sets the ramp current from R18. The values of R65 and R66 are selected to control the limits of the ramped control voltage. R62 and R64 are dividers to help establish practical resistor values for the regulator. CR17 protects the YIG circuit from excessively high voltages. The ramped output at E10 slopes linearly from +7V or greater to +15V.

In addition to its main tuning coil, YIG oscillator Y1 contains a second, smaller tuning coil. The second coil is the FM coil, used to frequency-modulate the YIG's output signal. An external dc voltage when applied to the FM jack located on the rear panel, will induce a frequency shift. A positive voltage will increase the frequency and vice versa. The low impedance of the FM coil requires a current driver to achieve linear drive and frequency deviation. Amplifier U6 and current driver Q10-Q11 are used to drive the FM coil. R58 is the FM current sensing resistor for driver Q10-Q11. The voltage across R58 controls the feedback through R52 and establishes the gain of the driver circuit. Potentiometer R50 is used to adjust the sensitivity. Diodes CR14 and CR15 provide forward bias for Q10 and Q11 to reduce cross-over distortion. Resistor R47 provides damping across the FM coil.

6.3.5 Control Logic

Using control inputs from the Model 6600 Mainframe, the logic circuits of the Model 6608EDA master board generate the control signals that set the two oscillator circuits in proper time sequence to generate the proper output frequencies.

The band select comparator circuit detects the proper band switching point on the plug-in's 0V +10V tuning ramp. The ramp is shown in Figure 6-2a and 6-3a. It is the summation of the 3 ramps from the 6600 mainframe, and is fed from the output of U3 to the negative input of U14. U14 is connected as a comparator, with a small positive feedback. A fixed positive voltage is also applied to the positive input of U14. When the ramp is at 0 volts, the - input of U14 is more negative than the + input, driving U14 output to the maximum positive voltage. As the ramp increases in voltage, the difference between the negative and positive inputs decreases. When they are within a few millivolts of each other, the output of U14 will change abruptly from maximum positive to maximum negative. The small positive feedback developed across R159 reduces the fixed voltage by approximately 40 mV; this forces the comparator to change states once it starts to change. The final voltage is adjusted so that band change will occur at the proper frequency. When the ramp voltage is more positive than the fixed voltage, U14 output will go negative, thereby driving the logic to select the high band.

The positive feedback will produce a hysteresis at band change. For an increasing frequency, the frequency switching hysteresis causes the band change point to be higher in frequency than the band change point for a decreasing frequency. This is necessary in order to avoid a band change from occurring when sweeping over very narrow bandwidths close to the band change point, i.e., 2.0 GHz.

Diodes CR46 and CR47 clamp the output of U14 for proper swing to drive the band switching logic. The clamped logic input is shown in Figure 6-2b. NAND gate U18-9, -10, -8 is used as an inverting buffer and shaper. Its output drives the high band FET switch driver Q9, the high band logic U18-4, -5, -6, and the dual direction sweep stop sensing circuit. See

Figure 6-2c. Inverter U18-12, -13, -11 drives low band FET driver Q8, low band logic U18-1, -2, -3, the U17 logic for the 4-port PIN switch/leveler, and the dual direction sweep stop sensing circuit. See Figure 6-2d.

The dual direction sweep stop sensing circuit detects the changing state of U14 in either direction of frequency change. Resistors R176 to R179 hold the inputs of U19-1, -2 at 2.8 volts , which is logic "1". U19-1, -2, -3 is a NAND gate; both inputs being at logic "1", the output is a "0". At band change, when U14 changes state, capacitor C50 and C51 will differentiate the changing state from U18-8 and U18-11. One pulse will be positive going, the other negative going. The negative-going pulse will change one of the U19-1, -2, -3 inputs from "1" to "0". This causes the output of U19-1, -2, -3 to change states, producing a pulse each time a band change occurs. These output pulses are shown in Figure 6-2e.

The pulses from U19-8, -11 are used to trigger two one-shots in U20, which provide proper dwell or sweep-stop times. U19-9, -10, -8 is an inverter used to supply the proper sweep-stop pulse polarity to the 2 ms one-shot U20-9. The output of this one-shot is shown in Figure 6-2g. The purpose of the one-shot is to provide, time for the YIG oscillator to change its frequency (sweep back) at band change and to come to rest before starting the sweep for the next band. NAND gate U19-12, -13, -11 provides the sweep-stop pulse to the 6 ms one-shot U20-1. This sweep-stop pulse is provided only when unblanking is selected on the front panel of the Model 6600 Mainframe. The signal from the Mainframe is 0 volts for blanking and +20V for unblanking. Diode CR45 clamps the unblank signal at +5.7 volts. The output of this one-shot is shown in Figure 6-2f. Its purpose is to provide time for re-establishing phase lock in network analyzers when the Model 6608EDA changes bands. Both the 2 ms and the 6 ms timing signals are combined in NAND gate U19-4, -5, -6. The output of the gate is used to drive transistor switch Q45. It is shown in Figure 6-2l. When output U19-6 is positive, it turns on switch Q45. The collector of Q45 is connected, via P1-43, to a +20 volt sweep stop supply in the Model 6600 Mainframe. Shorting this +20V to ground via Q45 stops the sweep in the Model 6600 Mainframe.

The 2 ms output from U20-12 is also used in the timing of the modulation gate and the drivers of PIN switches S1 and S2 (RF band switching). To provide proper synchronization, the 2 ms pulse supplied for RF band switching must be longer by approximately 3 μs than the pulse supplied for sweep stop. C52, R180 and CR49 provide this pulse stretching. The leading edge of the pulse is not delayed. It passes through CR49, discharging C52. The trailing edge is delayed by the recharging of C52 through R180. The pulse stretching is shown in Figures 6-2g and 6-2h.

The first section of U16 is a 4-input NAND gate. All the inputs are normally at logic "1" and the output is normally at "0". The second section of U16 is used as an inverter. U16 combines the pulsed AM, the blanking signal, the RF Off signal, and the 2 ms dwell signal. R171 through R175 are pull-up resistors. The summation of these four signals from U16-8 shown in Figure 6-2h drives the modulation gate, the low-band logic and the high-band logic. Modulation gate Q15 is controlled by Q16. Q16 is normally saturated. The AM pulse modulation signal from U16-2 turns Q16 off, which brings the -11V bias via R81 to gate off Q15. FET switch Q15 is placed in the leveling loop and is used to pulse modulate the loop for leveled pulses. These include AM pulses from the Model 6600 Mainframe, blanking pulses and band-change pulses.

NAND gate U18-1, -2, -3 is the low-band logic. It combines the low-band FET switch drive (shown in Figure 6-2d) with the modulation gate drive, to produce the drive to Q31 for low-band PIN switching. The drive waveform to Q31 is shown in Figure 6-2i. The low band will be turned on when both U18-11 and U16-8 are at logic "1". Then U18-3 is a logic "0", turning on the 2.2 GHz PIN switch.

The 2.2 GHz PIN switch S2 has two functions. When the low band is selected, the switch acts as the internal leveler for the low-band signal. When the high band is selected, the PIN switch becomes a high-loss attenuator blocking the flow of the 2.2 GHz RF signal, thereby turning off the low band. In order for the shunt PIN diodes inside the switch to turn off the low band, the diodes have to draw bias current. When properly forward biased, the diodes will shunt the RF 2.2 GHz signal to ground. To turn off the low band, a logic "1" from the low-band logic turns on Q31, turning on Q33. Q33 shunts

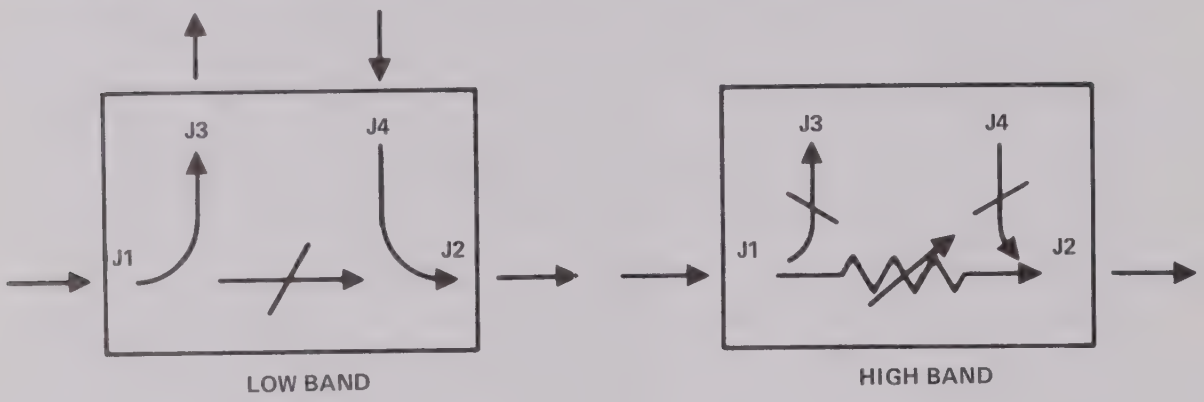
the bias of Q32 so that Q32 is turned off. R126 isolates Q33 from Q30. With Q32 off, the -11 volts is applied through R129, CR39, CR40 and R132 to the PIN switch. The current through the internal shunt diodes of the 2.2 GHz PIN switch S2 shorts the RF to ground.

NAND gate U18-4, -5, -6 is the high-band logic. It combines the high-band FET switch drive (shown in Figure 6-2c) with the modulation gate drive, to produce the drive to Q35 for high-band PIN switching. The drive to Q35 is shown in Figure 6-2j. The high band will be turned on when both U18-5 and U16-8 are at logic "1"; then U18-6 is at logic "0" turning on the high-band J1-J2 path through 4-port PIN switch/leveler S1.

Band-select logic U17 for the 4-port PIN switch consists of two AND gates. These gates combine the low band FET switch drive (Figure 6-2d), the 2 ms timing (Figure 6-2g), and the blanking from the Mainframe. The band-select switching of the 4-port switch requires three conditions in order to switch to the low band; all U17 inputs must lie at logic "1". Otherwise, the high band is selected. U17-8 provides the drive for band-select switching of the 4-port PIN switch. This drive is shown in Figure 6-2k. Transistors Q40, Q42, and Q43 provide the interface to driver transistors Q41 and Q44. The band-select drivers must supply current to the PIN diodes in both directions. Q41 supplies the positive current, for the high-band mode of operation. Q44 supplies the negative direction low-band current (shown in Figure 6-3i). R185 and R186 are current-limiting resistors. R187 provides additional current control for the negative direction. For low-band mode of operation, logic "1" turns off Q40 and Q41 while turning on Q42, Q43, and Q44. Current then flows from the PIN switch through R185, R186, R187 and Q44 to the -11V supply. For high-band operation, a logic "0" reverses the turning on at the transistors, and current then flows from the +5V supply through Q41, R185 and R186 to the PIN switch.

The 4-port PIN switch/leveler S1 contains 3 switched sections in one housing. Two sections are used for band switching only; they are represented by RF paths J1-J3 and J4-J1 in schematic diagram Figure 10-2. These two sections are driven from Q41 and Q44. The third section, represented by RF path J1-J2, has two functions. The first function is to provide internal

leveling when the Model 6608EDA plug-in operates in high-band mode. The second function is to switch off the high-band signal, by shunting it to ground during the low-band mode of operation. This is shown in the diagram below.



To turn off the high band, a logic "1" from high-band logic U18-6 turns on Q35, turning on Q34. Q34 shunts the bias of Q37 thereby turning off Q37. R143 controls the bias of Q37 and therefore the turning off threshold of Q37. The current from the +20 V supply then flows through R137, R199, CR42 and R140 to the PIN diodes, turning off the high band. To turn on the high band, Q37 draws current through R137 and R199, away from CR42 and R140. As the voltage at the emitter of Q37 drops below zero, current will flow out of the PIN switch, through R140, CR44, CR43, Q37 and R144 to the -11 V supply. In addition to the switched currents used to select the output frequency bands of the Model 6608EDA, a fixed bias is applied to some of the PIN diodes of switch A2S1. This bias is about +0.7 volts and is supplied through R197 to switch terminals A and C. It is voltage-regulated by shunt diode CR54.

In some applications of the Model 6608EDA plug-in, the blanking of the RF signal may be desirable in order to eliminate the effects of the tuning current retrace. Blanking is controlled from the Model 6600 Mainframe and causes changes in the retrace lengths of the Model 6608EDA plug-in, as seen in the various timing diagrams shown in figure 6-2. The blanking control signal from the Model 6600 Mainframe is +20 V for blanking off and 0 V for blanking on. The +20 V signal is clamped at +5.7 V by CR45, and is applied

to the logic U16-2, U17-13 and U19-13. The logic supplies the proper signal to the modulation gate Q15 as well as PIN drivers Q32, Q37, Q41 and Q44 to turn the RF power off during retrace when blanking is selected.

6.3.6 Leveling

The internal leveling loop of the Model 6608EDA plug-in is a feedback loop which detects the RF level at the output port, processes this detected signal and uses it to control the attenuation of the PIN diode attenuators of switches A2S1 and A2S2. By varying the attenuation, the level of the RF output signal is varied. The end result is an RF output signal which maintains a near-constant power level over the 0.01-4.2 GHz frequency range.

Internal sampler A2HY1 detects the RF signal, producing a negative-polarity dc voltage that is proportional to the RF signal level. This internal-leveling signal is filtered by an R-C filter in the sampler to remove any RF components. The signal is then fed, via shielded cable W8, to J4 on the master board, where its amplitude is adjusted by R76 and R77. U10, a non-inverting buffer, is used to isolate the sampler from the loading effects of the remaining leveling loop circuitry. See waveform of figure 6-3b. Three FET gates, Q17, Q19 and Q21, are used to select sampler information to be used by the leveling-loop amplifier. FET gate Q17 is used to couple the internal sampler to the main leveling loop amplifier Q24, Q25, Q26, and Q27.

Leveling loop adder U9 is an inverting amplifier that combines the leveling loop control signals. These four control signals are: Linear AM modulation; markers from Model 6600 Mainframe, front panel LEVEL CONTROL; and internal sampler slope correction. Slope correction is used only with the internal sampler. The purpose of the correction is to provide a flatter internally leveled output. A small portion of the ramp from U3, controlled by R9, R10 and R72, is combined in U9, thus changing the leveling loop slope. FET switch Q14 turns on the slope correction circuit when internal leveling operation is selected on the front panel. A second input is provided via LEVEL CONTROL potentiometer, A3R4, the RF level control located on the front panel and shown in schematic diagram figure 10-3. This control is connected to U9 at points "A" and "B" on schematic diagram figure 10-1. Varying the LEVEL CONTROL varies the feedback around U9,

thereby changing the adder's gain. U9 has a small fixed input from the +10.5 V supply via R73. This input is amplified, the gain depending upon the LEVEL CONTROL setting. U9 output thus varies with the adjustment of LEVEL CONTROL varying the dc level of the leveling loop amplifier.

In the leveling loop amplifier, the sampler signal and the control signal are combined to produce the leveling loop signal. The leveling loop amplifier has a differential input. The sampler signal from U10-U12 drives the base inputs of the leveling loop balanced amplifier Q24 and Q26. The control signal from U9 requires an emitter follower Q23 to drive the emitters of Q24 and Q26. See figure 6-3c for control waveforms. The emitter follower causes a signal offset of +0.7 volts. To maintain balance in Q24 and Q26 with the offset drive from Q23, the leveling signal is also off-centered, using diode string CR28 thru CR31. The purpose of diode CR27 is to protect the leveling loop amplifier input from positive transients.

The leveling loop amplifier is capable of fast slew rates and high output currents coupled with high source impedance. The frequency response of the leveling loop is limited by the total phase shift around the loop. This includes the phase shift of the amplifier, the time required by the PIN switch to change its attenuation, and the time delay required by the sampler to change its detected output. The frequency response is determined by the values of C43 and R107; since the source impedance of the leveling loop amplifier is high, C43 can be relatively small to achieve the proper RC time constant. The leveling loop amplifier can supply a relatively large current, thereby charging and discharging C43 rapidly. This makes for a fast acting leveling loop. When the leveling loop amplifier moves in or out of leveling, the amplifier will slew to the +20 V and -11 V power supply limits. This is wasted slew time. Diodes CR23 and CR33 are used, therefore, to clamp the amplifier at -1.4 V in the negative direction. Diodes CR34 and CR35 clamp the amplifier at +5.4 volts in the positive direction. Thus in leveling, the amplifier slew time has been reduced by restricting its voltage range.

Q30 is an emitter follower stage, used to minimize the loading on C43 and isolate the frequency determining components of the leveling loop. Q30 delivers the leveling loop signal to three circuits: The low-band leveling PIN driver, the high-band PIN driver, and the unleveled sensing comparator.

A multi-hole ferrite bead Z1 is placed over the three leads of Q30 to suppress RF oscillations. The leveling loop signal can be monitored at TP4. See figure 6-3d for waveform.

The low-band leveling PIN driver Q32 drives the shaping network and the 2.2 GHz PIN switch A2S2. The low-band shaping network, consisting of CR39, CR40, R130, R131 and R132, produce a more linearized RF signal level change in the PIN switch in response to a linear voltage change at the base of Q32. This is done so that the leveling loop gain will not change much over the LEVEL CONTROL range. The switching function of Q31 and Q33 is discussed in paragraph 6.3.5. See figures 6-3e and 6-3f for waveforms of low-band leveling and band change.

The high-band leveling PIN driver requires that the leveling loop signal be offset, in order to deliver the proper voltage slope to the attenuator section of PIN switch A2S1. The offset is established by zener diode CR41. R135 maintains a current flow in CR41. Q36 inverts the signal and Q37 drives the shaping network and the 4-port PIN switch/leveler. The high-band shaping network consisting of CR43, CR44, R138, R139 and R140, produces a more linearized RF signal level change in the 4-port PIN switch/leveler in response to a linear voltage change at the base of inverter Q36. Potentiometer R143 adjusts the offset of the high-band leveling PIN driver. Its purpose is to set the level of the high-band RF output to that of the low-band output resulting in a continuous output over the 0.01-4.2 GHz band. The switching function of Q34, Q35 and CR42 is described in paragraph 6.3.5. See figures 6-3g and 6-3h for waveforms of high-band leveling and band change.

The unleveled sensing circuit provides a front-panel indication about the status of the leveling loop. In the leveled mode, when the loop's signal at TP4 is above +3.5 volts, the leveling loop is not leveling. R140 is used to set the voltage at the base of comparator Q39B to approximately +3.5 volts. The leveling loop signal from Q30 is applied to the base of Q39A. As long as the leveling loop signal is less than +3.5 V, Q39B is turned on and Q39A is turned off. With Q39A off, no current flows through R147 and Q38 remains off as does the "UNLEVELED WHEN LIT" LED lamp CR55. When the loop signal is above the +3.5 V setting of R150, Q39A conducts and Q38 is turned on supplying current through R151 to lamp CR55.

In the unleveled mode, when "UNLVL" is selected on the front panel, the switch supplies +5 volts to turn on Q29. Q29 then operates relay K3 and turns on Q39 and CR55. K3 breaks the leveling loop at the output of the leveling loop amplifier and connects the control signal from U13 to the leveling loop through Q30. The sampler signal has thus been removed from the loop. U13 receives the control signal from U9, inverts and amplifies it. U13 also offsets the control signal, to condition it for driving Q30 and leveling PIN drivers Q32, Q37. Potentiometers R114 and R115 set the operating limits of amplifier U13 and the front panel LEVEL CONTROL; R114 controls the range and R115 the minimum-power limit. The Model 6608EDA plug-in is capable of operating in three different leveling modes: Internal leveling using sampler A2HY1; external leveling using a negative-polarity sampler; external leveling using a positive-polarity sampler. Front-panel and side-panel switches are used to select the desired sampler. These switches work in conjunction with the sampler select circuits located on the master board. Three sampler select gates, controlled by the panel switches, are used to select the desired sampler signal. These gates are FET switches Q17, Q19, and Q21. The sampler FET switches are turned on by saturation of transistors Q18, Q20 and Q22. The panel switches control the sampler select gates by supplying a +5 V bias; this bias is used to selectively turn on or off Q18, Q20 and Q22. This removes the -11 V bias supplied through R84, CR24, R91, CR25, R96, and CR26. In external leveling mode of operation, select gate Q17 is turned off, turning off the internal sampler signal. Select gates Q19 and Q21 turn on the external sampler signal. These two gates are selected by the right side panel + - EXT LEVELING slide switch A3S4. With negative detection, the signal is amplified by U11 and applied to the leveling loop amplifier through Q19. Inasmuch as the leveling loop amplifier requires a negative input, a positive detector signal will be amplified by U11 and inverted by U12 before being applied through Q21 to the amplifier. R86 and C59 help stabilize U11 if coax cable W5 and front panel SENS potentiometer are disconnected from J5 during testing and maintenance. U11 provides gain for the external sampler signal. The level of the external sampler signal can be adjusted by the SENS screwdriver potentiometer located on the front panel.

In addition to inputs from external samplers, the Model 6608 EDA plug-in has provisions for accepting an external leveling signal from microwave power meters. Power meter leveling is an external leveling method, using the power meter and its bolometer-sensor as the external detector. The power meter's output must have positive polarity.

When leveling the plug-in with an external sampler, consisting of a directional coupler and crystal detector, the PWR MTR LVL switch located on the rear panel must be off to obtain normal leveling loop response. When power meter leveling is desired, the PWR MTR LVL switch is set to ON and the "+ - EXT LEVEL" side-panel switch to +. This will turn on Q28 and relay K2. K2 connects R201 and C56 into a feedback circuit of the leveling loop, resulting in a 0.08 second rise time. This reduces the leveling loop's frequency response so that it will be compatible with a power meter. When a highly-damped, slow power meter is to be used, adding jumper wire W4 on the master board will connect R108, C44 and C45 in parallel with R201 and C56 resulting in a 0.25 second rise time for the loop; this further reduces the frequency response of the leveling loop.

The Model 6608EDA supplies a ramped output synch voltage for use with external test equipment such as network analyzers and X-Y recorders. This is a positive-sloped voltage proportional to output frequency (VPF) available at the NTWK ANAL jack on the rear panel. VPF amplifier U15, Q46 and Q47 converts a +10V to -10V linear ramp from the Model 6600 Mainframe into a +0.1 V to +42.0 V linear ramp, which corresponds to a 10 mV/MHz VPF ratio. U15 inverts the input VPF ramp and provides gain. Q46 and Q47 drives the output. R196 provides the feedback and sets the total gain. R170 provides a fixed source impedance at the output port. R163 adjusts the offset or +0.1 V low-end of the ramp while R160 adjusts the gain or +42.0 V high-end. The collectors of Q46 and Q47 are supplied +62 V from the Model 6600 Mainframe. This voltage is required to obtain a 42 V output range.

Section VII
MINIMUM PERFORMANCE PROCEDURES

7.1 SCOPE

The minimum performance procedures contained in this section may be used to verify the proper functioning of the Model 6608EDA plug-in and to ascertain that its performance is within the equipment specification limits. The equipment specifications are listed in Section II.

The minimum performance tests are performed with the plug-in installed in a Model 6600 Sweep Oscillator Mainframe. Access to the instrument's interior is not required for performance of the tests. All testing is done at room temperature.

7.2 TEST EQUIPMENT

The test equipment required for conducting the minimum performance tests is listed in Table 7-1. For each item listed, its minimum (or critical) parameters are shown as well as recommended vendor and model number.

All test equipment used in the performance of these tests must be in-calibration and in satisfactory operating condition. Prior to start of testing, allow test equipment and plug-in under test to warm-up for a minimum period of 30 minutes.

7.3 MINIMUM PERFORMANCE TESTS

7.3.1 Frequency Dial Accuracy

Manually tune the Model 6608EDA, in CW mode, to the following eleven dial settings: 0.01, 0.5, 1.0, 1.5, 1.9, 2.1, 2.5, 3.0, 3.5, 4.0, and 4.2 GHz. At each dial setting, measure the actual output frequency using a counter.

TABLE 7-1. TEST EQUIPMENT REQUIREMENTS FOR MINIMUM PERFORMANCE TESTS

Instrument	Minimum Parameters	Recommended Model
Sweep Oscillator Mainframe	All voltages and controls for operating the Model 6608EDA Plug-in.	Singer 6600
Spectrum Analyzer	Frequency range: 10 MHz to 12.6 GHz	Hewlett-Packard 8555A/8552B/141T
Frequency Counter	Frequency range: 10 MHz to 4.2 GHz	Hewlett-Packard 5340A.
Network Analyzer with Display	Frequency range: 100 kHz to 4.2 GHz Sensitivity: -40 dBm to +20 dBm	Singer 8000/7051
Crystal Detector	Linear at +10 dBm	Singer 1001
Detector Video Filter	Compatable with crystal detector	Singer 1405
Function Generator	Frequency range: 1 kHz to 30 kHz DC offset: +5 volts Output level: 12V p-p Output: sine, square, triangle	Wavetek 134
Power Meter with Sensor	Frequency range: 10 MHz to 4.2 GHz Power range: to 100 mW	Hewlett-Packard 435A/8481A
Oscilloscope with Plug-in	Frequency range: dc to 50 MHz Sensitivity: 50 mV/cm	Tektronix 547/1A1
Digital Voltmeter	Voltage range: 0 to ±100V dc Accuracy: 0.01 percent	Fluke 8350A

The required frequency tolerances are 0.0 to 0.02, 0.485 to 0.515, 0.98 to 1.02, 1.475 to 1.525, 1.881 to 1.919, 2.08 to 2.12, 2.48 to 2.52, 2.98 to 3.02, 3.48 to 3.52, 3.98 to 4.02, and 4.18 to 4.22 GHz respectively.

7.3.2 Frequency Pulling

Set F_o control to 1000.00 MHz, as read on frequency counter. Set output power level to +10 dBm, internally leveled, as measured on a power meter.

Decrease output power to 0 dBm. The frequency change shall be less than 1.5 MHz.

Set output frequency to 3000.00 MHz and output power to +10 dBm. Decrease output power to 0 dBm. The frequency change shall be less than 250 kHz.

7.3.3 RF Output Power

Calibrate the network analyzer for a sensitivity of 0.5 dB/cm. On the Model 6600, set sweep mode to FULL BAND and Marker M2 at 4.0 GHz. The plug-in under test is internally leveled.

Display the detected RF output on the network analyzer. Adjust LEVEL CONTROL until the swept output over the 0.01-4.0 GHz range has its maximum leveled output power.

On Model 6600 Mainframe, change sweep mode to CW. Manually tune over the 0.01-4.0 GHz band while noting the lowest and highest output power levels on the power meter. The lowest measured leveled power output shall be greater than 10 mW.

The difference between the lowest and highest leveled power output shall be less than ±0.5 dB.

The output over the 4.0-4.2 GHz range may or may not be leveled; however, the output level shall be greater than 5 mW.

Switch sweep mode to FULL BAND. Observe the RF response on the network analyzer. Verify that the displayed swept RF is still leveled over the 0.01-4.0 band of operation.

On network analyzer, note the dialed power level. Then turn the LEVEL CONTROL fully ccw, and note the reduced power level. Calculate the difference in power levels. The power level change shall be greater than 10 dB.

7.3.4 Spurious Signals

Set sweep mode to CW and LEVEL CONTROL for +10 dBm output at 1 GHz. Connect RF output to a spectrum analyzer.

Manually tune the Model 6608EDA frequency over the 0.01-4.2 GHz range while tracking the RF signal and its related harmonics on the spectrum analyzer. The worst-case harmonic level, at +10 dBm fundamental frequency power level, shall be greater than 18 dB below the fundamental frequency power level.

Manually tune the Model 6608EDA over its band of operation while observing on the spectrum analyzer the non-harmonically related spurious signals. The worst-case non-harmonic spurious signals shall be greater than 35 dB below the fundamental frequency power level.

7.3.5 Residual FM and AM

On Mainframe, set sweep mode to CW and output frequency to 1 GHz. On spectrum analyzer, set bandwidth to 10 kHz and scan width to 10 kHz/division. With its output level at +10 dBm, connect the Model 6608EDA to the spectrum analyzer and display the sweeper's output signal.

Center the displayed 1 GHz output. The residual FM shall be less than 15 kHz peak to peak.

Tune the sweeper to 3 GHz and display the sweeper's output signal. The residual FM shall be less than 15 kHz peak to peak.

Adjust the F_o control to 1 GHz and set the analyzer's scan width to 100 kHz/division and bandwidth to 10 kHz. Display and center the 1 GHz signal. The residual AM 200 kHz away from the signal peak, on both sides of the carrier shall be greater than 50 dB down.

Tune the sweeper to 3 GHz and display the sweeper's output signal. The residual AM 200 kHz away from the signal peak, on both sides of the carrier, shall be greater than 50 dB down.

7.3.6 Internal Square-Wave Modulation

On Model 6600 Mainframe, press AM, BLANKING, and FULL BAND; set AM MODE rear-panel switch to INT SQ WAVE. On Model 6608EDA, press INT LEVELING. Terminate the detector-filter with a 600-ohm load.

Display the detected square-wave signal on the scope. The rise time between 0.01 and 4.0 GHz shall be less than 5 μs and the fall time shall be less than 1 μs.

Remove the 600 Ω load from the detector-filter. Disconnect the detected output from the scope and connect it to the network analyzer. Set network analyzer sensitivity to 10 dB/cm. The on/off ratio displayed on the network analyzer shall be greater than 40 dB.

7.3.7 External AM Pulse Modulation

On Model 6600 Mainframe, press AM, BLANKING, and FULL BAND. Terminate the detector-filter with a 600-ohm load.

On function generator, set function to square wave, frequency to 30 kHz, output voltage to 0 V in OFF condition, +5V ON condition. Connect function generator to the OFF/ON PM IN jack located on rear panel of the Model 6600 Mainframe; set AM MODE switch to external. The leveled rise time between 0.01 and 4.0 GHz shall be less than 5 μs and the unleveled rise time shall be less than 3 μs. On the scope, the observed symmetry of the square wave shall be better than 40/60 percent.

Remove the 600 Ω load from the detector-filter. Disconnect the detected output from the scope and connect it to the network analyzer. Set network analyzer sensitivity to 10 dB/cm.

On network analyzer, the on/off ratio shall be greater than 40 dB.

7.3.8 AM Modulation Factor

On function generator, switch DC OFFSET to OFF, function to 12 volts peak-peak sine wave, and frequency to 1 kHz. On sweeper, set up for a full-band leveled sweep at +3 dBm output power. After power leveling has been set, connect output of function generator to the AM jack located on rear panel of the Model 6608EDA plug-in. Display the detected modulation output on the scope. The modulation shall be greater than 50 percent.

7.3.9 FM Modulation

On function generator, set function to 12 volts peak-to-peak triangle. Connect function generator output to FM jack located on rear panel of

Model 6608EDA plug-in. On Model 6600 Mainframe, set sweep mode to CW and frequency at 1 GHz. Connect sweeper output to spectrum analyzer. On spectrum analyzer, set bandwidth to 10 kHz and scan width to 10 MHz/division.

On spectrum analyzer, display the frequency-modulated 1 GHz carrier. The FM deviation shall be greater than ±20 MHz.

7.3.10 Blanking

On Model 6600 Mainframe, set sweep mode to FULL BAND. On oscilloscope, set vertical sensitivity to 0.2 volts/cm and display the swept RF output. Observe the displayed trace while switching the blanking on and off several times on the Model 6600 Mainframe. Verify that the RF blanking is functioning properly.

7.3.11 Markers

On Model 6600 Mainframe, turn MARKER switch on and MARKER AMPL fully cw. On network analyzer, set vertical sensitivity to 5 dB/division and display the swept RF output with the three markers.

Vary the frequency of markers M1, F_o and M2. Verify that the displayed markers track their control setting changes. The depth of the marker pips shall be 15 dB or more below the +10 dBm swept RF level.

7.3.12 Level Indication

On Model 6600 Mainframe, turn off the markers. On network analyzer, change the vertical sensitivity to 1.0 dB/division and display the swept RF output. On Model 6608EDA, turn LEVEL CONTROL fully cw.

Observe the displayed RF on the network analyzer and the UNLEVELED WHEN LIT indicator on the Model 6608EDA, unit under test. The lamp should be lit at this maximum RF output. Now slowly turn LEVEL CONTROL ccw until the displayed RF is leveled over the entire 0.01-4.2 GHz band. The lamp should go off when this leveled RF output is reached.

7.3.13 Voltage Proportional to Frequency

On Model 6600 Mainframe, set sweep mode to CW. Connect NTWK ANAL jack, located at rear of the Model 6608EDA plug-in, to voltmeter

Tune frequency to 0.01 GHz and observe the measured voltage. The voltage shall be between 0 and +0.2V.

Tune frequency to 4.2 GHz. The voltage shall be between +41.5V and 42.5V.

Section VIII
MAINTENANCE

8.1 INTRODUCTION

This section contains information for the maintenance of the Model 6608EDA. Included are Disassembly Procedures, Alignment Procedures and Fault Isolation Procedures.

8.2 GENERAL INFORMATION

8.2.1 Alignment Interval

To ensure instrument accuracy, check the Model 6608EDA performance using the Minimum Performance Procedure presented in Section VII, every 1000 hours of operation, or every six months if the instrument is only used occasionally.

8.2.2 Alignment and Adjustment Procedures Defined

The completion of each step of the alignment and adjustment procedure (refer to Paragraph 8.6) ensure that the instrument meets the electrical specification of Section II. For best overall performance when performing a complete Alignment and Adjustment Procedure, adjust each potentiometer as close as possible to the exact value, even though the Minimum Performance Procedure indicate that the operation is within the allowable tolerance.

8.2.3 Interchangeability

The Model 6608EDA Plug-in unit when aligned using a Model 6600 Mainframe that is operating within its specifications will operate satisfactorily in any other correctly operating Model 6600 Mainframe.

8.3 TEST EQUIPMENT REQUIRED

Test equipment used in this section is listed in Table 8-1. Minimum specifications are listed to aid in the selection of equivalent types.

TABLE 8-1. MAJOR TEST EQUIPMENT

Instrument	Minimum Parameters	Recommended Model
Sweep Oscillator Mainframe	All voltages and controls for operating the Model 6608EDA Plug-in	Singer 6600
Test/Extender Drawer		Singer 6602A
Network Analyzer with Display	Frequency range: 100 kHz to 4.2 GHz Sensitivity: -40 dBm to +20 dBm	Singer 8000/7051
Crystal Detector	Linear at +10 dBm	Singer 1001
Detector Video Filter	Compatible with crystal detector	Singer 1405
Spectrum Analyzer	Frequency range: 10 MHz to 12.6 GHz	Hewlett-Packard 8555A/8552B/141T
Frequency Counter	Frequency range: 10 MHz to 4.2 GHz	Hewlett-Packard 5340A
Frequency Meter	Frequency range: 1.9 to 2.1 GHz	Hewlett-Packard 536A
Power Meter with Sensor	Frequency range: 10 MHz to 4.2 GHz Power Range: to 100 mW	Hewlett-Packard 435A/8481A
Oscilloscope with Plug-in	Frequency Range: dc to 50 MHz Sensitivity: 50 mV/cm	Tektronix 547/1A1
Digital Voltmeter	Voltage range: 0 to ±100 Vdc Accuracy: 0.01 percent	Fluke 8350A
Function Generator	Frequency range: 1 kHz to 30 kHz DC offset: +5V Output level: 12 V p-p Output: sine, square, triangle	Wavetek 134

8.4 DISASSEMBLY PROCEDURE

8.4.1 Mechanical Disassembly

Occasionally, during the performance of maintenance, it may be necessary to disassemble portions of the Model 6608EDA plug-in to gain access to its various components. Instructions for the mechanical disassembly are given below.

8.4.2 Removal of Top and Bottom Covers

The removal of the top and bottom covers provides sufficient access to the subassemblies for most alignment and component replacement operations. Remove the eight #4-40 x 1/4 flat head screws from each cover. Detach the covers from the instrument.

8.4.3 Removal of Rear Panel

Disconnect the four cables W9, W10, W11 and W12 from the four master board jacks, J6, J2, J3 and J7 respectively. Loosen the #4-40 x 1/4 pan head screw holding the master board to the rear panel. Remove the four #4 flat head screws located in each corner of the rear panel. Remove the rear panel.

8.4.4 Removal of Master Board/RF Deck

Disconnect the two cables W5 and W6 from master board jacks J5 and J1 respectively.

CAUTION

The pins in the plugs of W6 (the flat-wiring cable) are small and sharp. Handle gently to prevent a puncture wound and bending the plug pins.

Remove the four #8-32 x 1/4 flat head screws from the left side panel. Slide the master board and RF deck assembly through the rear of the Model 6608EDA.

8.4.5 Separation of RF Deck from Master Board

Following the removal of the Master Board/RF Deck assembly from the instrument, it may be necessary to separate the RF deck A2 from the master board A1. Remove the two #6-32 x 1/4 pan head screws connecting the master board to the RF deck. Separate the two assemblies.

8.4.6 Removal of YIG Oscillator

When the replacement of YIG oscillator Y1 is indicated, the master board/RF deck assembly is removed from the Model 6608EDA chassis and the RF deck is separated from the master board, per above disassembly procedure. Unsolder the leads from the YIG oscillator terminals and snip the 2 leads of encapsulated temperature-control diode CR1 at their terminals. Loosen the four screws holding the oscillator body to its bracket. Loosen one end of semi-rigid cable W13.

8.5 PRELIMINARY ALIGNMENT PROCEDURE

8.5.1 Need for Preliminary Alignment

Normally, the use of preliminary alignment will not be required and should be avoided unless the equipment has undergone major repair. The object of preliminary alignment is to provide approximate settings of controls and selected components so the instrument will function though not at a calibrated level prior to making final adjustments. Usually, the internal control settings of an instrument that has once been aligned will always be superior to a preliminary setting. Two examples that would call for use of preliminary settings are:

Example 1 – Replacement of YIG oscillator Y1. This requires performing Paragraphs 8.5.2, 8.5.3, and the preliminary setting of controls R12, R14, R37 and R41 listed in Table 8-2. Then proceed to final adjustment procedure.

Example 2 – Maladjustment of one or more internal controls listed in Table 8-2. Adjust only those controls that are know to be out of adjustment to the settings provided in the table. Then proceed to final adjustment procedures.

TABLE 8-2. MASTER BOARD ALIGNMENT CONTROLS

Control	Turns*
R12	50 percent
R14	50 percent
R37	50 percent
R41	50 percent
R10	ccw
R30	50 percent
R34	ccw
R160	50 percent
R163	50 percent
R154	50 percent
R76	50 percent
R115	50 percent
R114	cw
R150	50 percent
R50	ccw
R143	50 percent

*To adjust a potentiometer to 50 percent resistance, turn its adjustment screw 25 turns ccw, then rotate it 12 turns cw. To adjust a potentiometer to fully ccw, turn its adjustment screw 25 turns ccw. For R34 only, turn it fully counter clockwise; then, using an ohmmeter, slowly turn it cw until the wiper arm is engaged in the minimum resistance position.

8.5.2 YIG Oscillator Replacement

Mount the new YIG oscillator to the RF deck. Using epoxy cement, bond the temperature controlling diode, type 1N4148, to the side wall of the oscillator, observing diode polarity. See Figure 10-2 for wiring information. After installing the new oscillator, adjust the driver circuit per Paragraph 8.6.10 and the temperature-compensation circuit per Paragraph 8.6.13.

8.5.3 YIG Driver Resistor Values

Whenever YIG oscillator Y1 is replaced, the factory-selected resistors R13, R24, R25, R38, R40 (and, if used, R65 and R66) must be replaced.

Using the electrical data supplied with the replacement YIG oscillator, the required values of the new driver resistors may be calculated.

The value of resistor R38 may be calculated using the following equation:

$$R38 = \frac{10.5}{\frac{10.5}{21K} + \frac{25}{10K}\left[I_{2.0} + \frac{0.21}{2.2}(I_{4.2} - I_{2.0})\right]} - 11K$$

where:

$I_{2.0}$ = YIG tuning current at 2.0 GHz
$I_{4.2}$ = YIG tuning current at 4.2 GHz

The value of R13 may be calculated using the following equation:

$$R13 = \frac{4.75}{\frac{25}{10K} I_{4.2} - \frac{10.5}{11K + R38} + \frac{10.5}{21K}} - 0.5K$$

The value of R40 may be calculated using the following equation:

$$R40 = \frac{10.5}{\frac{25}{10K} I_{2.0} - \frac{4.75}{0.5K + R13} + \frac{10.5}{21K}} - 11K$$

The value of R24 may be calculated using the following equation:

$$R24 = \frac{1}{\frac{1}{0.5K + R13} + \frac{1}{11K + R38} + \frac{1}{21K} + \frac{1}{200K}} - 4.02K$$

The value of R25 may be calculated using the following equation:

$$R25 = \frac{1}{\frac{1}{0.5K + R13} + \frac{1}{11K + R40} + \frac{1}{21K} + \frac{1}{200K}} - 4.02K$$

The value of R65 may be calculated using the following equation:

$$R65 = \frac{\left(V_{2.0}\, I_{4.2}\right) - \left(V_{4.2}\, I_{2.0}\right)}{V_{4.2} - V_{2.0}} \quad (50K)$$

where:

$V_{2.0}$ = YIG oscillator transistor voltage at 2.0 GHz
$V_{4.2}$ = YIG oscillator transistor voltage at 4.2 GHz

The value of R66 may be calculated using the following equation:

$$R66 = \frac{\left(V_{2.0}\, I_{4.2}\right) - \left(V_{4.2}\, I_{2.0}\right)}{I_{4.2} - I_{2.0}} \quad (2K)$$

8.5.4 Potentiometer Pre-Sets

Whenever the setting of a tuning potentiometer is questionable, the potentiometer should be re-set to the nominal pre-setting listed below. The circuit should then be aligned using the appropriate alignment procedure provided herein.

Pre-set the wiper arm of the multi-turn potentiometers on the master board to the settings listed in Table 8-2. Refer to Figure 8-1 for the location of these controls.

8.5.5 Preliminary Voltage Checks

The following procedure is used to verify that the Model 6600 Mainframe is supplying the correct operating voltage to the Model 6608EDA.

a. To protect a replacement YIG oscillator, remove fuses F1 and F3 from their socket pins on the master board.

b. Pre-set the controls of the Model 6600 Mainframe as follows:

Sweep mode . . . . . Full Band
Sweep Time 0.01
Trigger . . . . . Int
RF . . . . . (none)

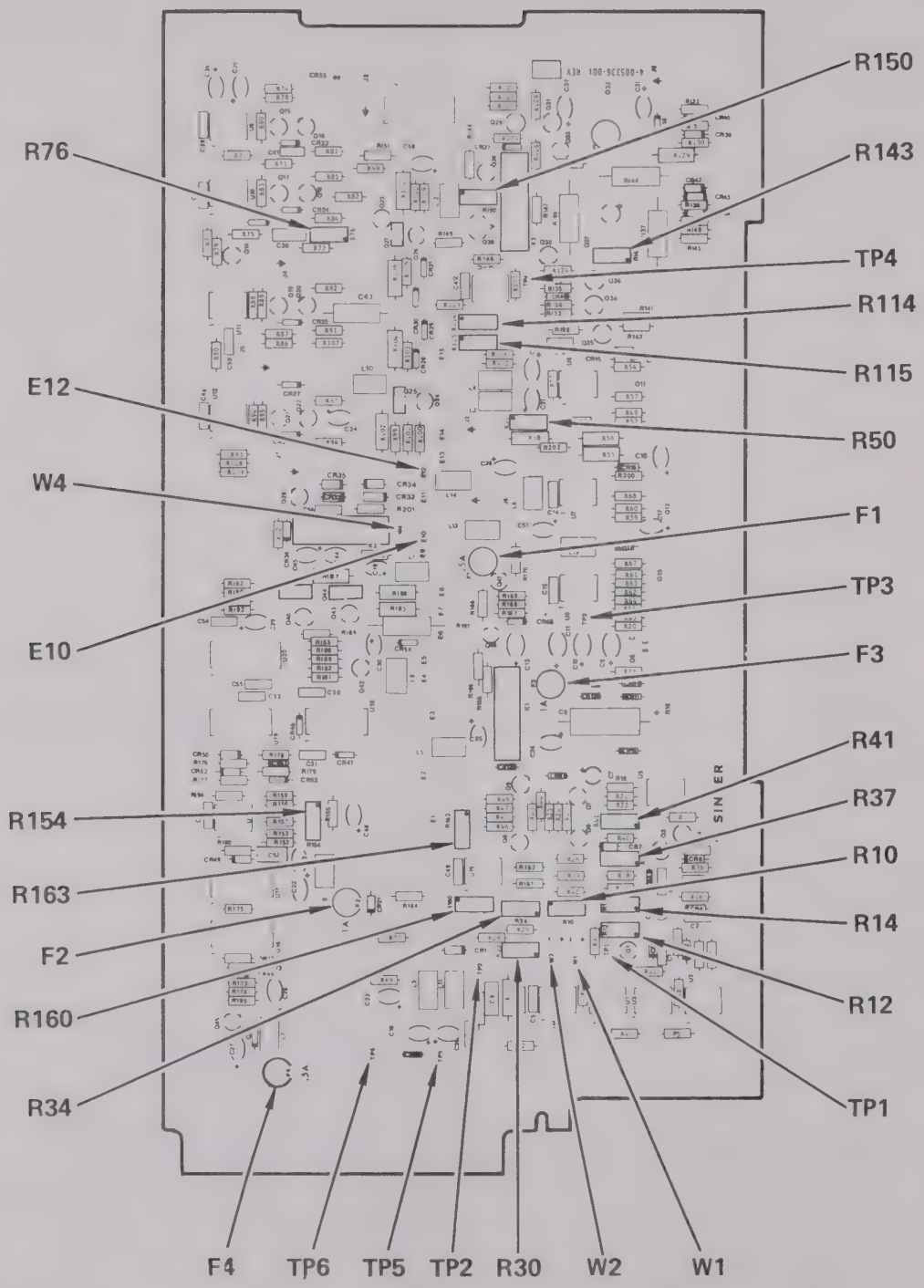


Figure 8-1. Master Board Component Locations.

c. Plug a Model 6602A Test/Extender Drawer into the Model 6600 Mainframe. Plug the Model 6608EDA unit under test into the Model 6602A Extender. On Model 6600 Mainframe, turn POWER on.

d. Measure the voltages at the test pins on the Model 6602A Extender. Nominal voltages should be:

Pin	Voltage
+20 V	+20 V
-20 V	-20 V
+10.5 V	+10.5 V
-10.5 V	-10.5 V
+62 V	+62 V
+ Prog	+5 V
- Prog	-11 V

8.5.6 Tuning Currents, Voltages and Waveforms

Make the following checks:

a. With the sweeper operating in the unblanked FULL BAND sweep mode check the ramp voltage by connecting a scope probe to test point TP1 on the Model 6608EDA master board. The ramp waveform shall be as shown in Figure 8-2. The 5 millisecond sweep-stop dwells are generated in the Model 6600 Mainframe while the 6 ms dwells are from the Model 6608EDA Plug-in under test.

b. On the Mainframe, switch from unblanked to blanked FULL BAND sweep mode. The rame waveform, as monitored at TP1, shall now appear as seen in Figure 8-3.

c. Insert 1.0 A fuse F3 into the master board (if removed as in Paragraph 8.5.5). Check the YIG oscillator tuning current by connecting the scope probe to TP3. The tuning current waveform shall be as shown in Figure 8-4.

d. Insert 0.5A fuse F1 into the master board (if removed as in Paragraph 8.5.5). Check the YIG oscillator transistor voltage by connecting a digital multimeter to Terminal E12 on the master board. The transistor voltage shall read +14.9 to +15.2 V.

e. Some Model 6608EDA Plug-in units, using -002 master boards, require an additional, ramped control voltage for their YIG oscillator. Check the ramped control voltage by connecting the scope to terminal E10. The end voltages shall be as specified on the YIG oscillator data sheet.

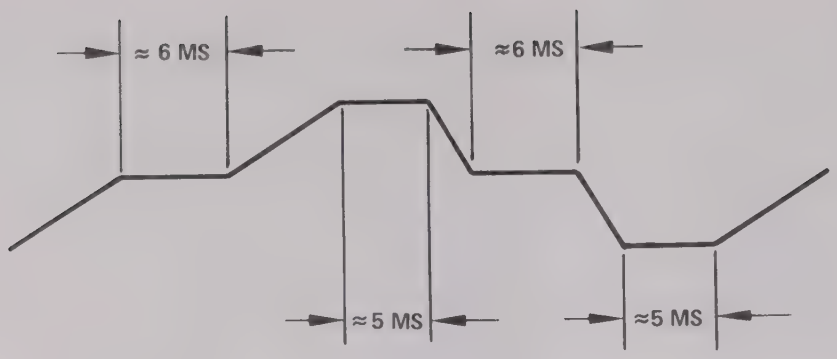


Figure 8-2. Ramp Voltage Waveform, Unblanked FULL BAND Sweep Mode.

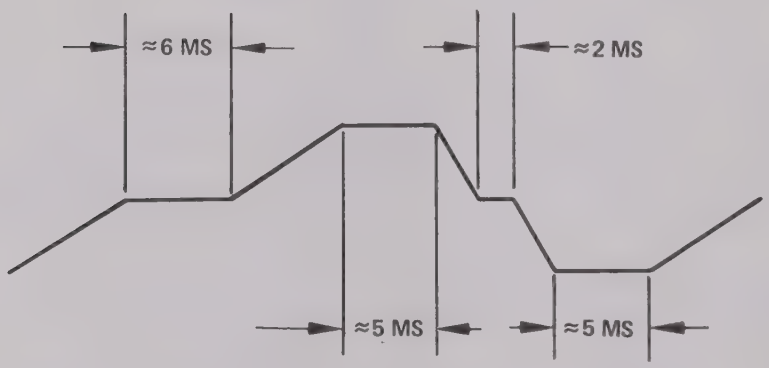


Figure 8-3. Ramp Voltage Waveform, Blanked FULL BAND Sweep Mode.

Figure 8-4. YIG Oscillator Tuning Current Waveform.

8.5.7 Preliminary Check of RF Power Output

Make the following checks:

a. Check the RF output of the Model 6608EDA by connecting a detector to its output port and displaying the swept output on the scope. The displayed output shall be free of glitches or other abnormalities over the entire 0.01-4.2 GHz band.

b. Check the RF output level of the Model 6608EDA by connecting a power meter to its output port and sweeping the unit manually over the 0.01-4.2 GHz band. Make sure that the unit is capable of internal leveling and the "UNLEVELED WHEN LIT" light is functioning. The output level shall be approximately 10 mW over the 0.01-4.0 GHz band, and 5 mW over the 4.0-4.2 MHz band.

c. Check that the LEVEL CONTROL is functioning by varying it and observing the corresponding output power changes.

NOTE

This completes the preliminary alignment and checking of the Model 6608EDA plug-in. If the unit is performing normally, proceed to the fine-tuning and adjustment procedures below. If the unit under test is not functioning normally, troubleshoot before proceeding.

8.6 ALIGNMENT PROCEDURE

8.6.1 Level Range Adjustment

a. Calibrate a Singer Model 8000/7051 Network Analyzer. Connect the output of the Model 6608EDA under test to the network analyzer.

b. On the Model 6600 Mainframe, set sweep mode to FULL BAND. On the Model 6608EDA, set LEVEL CONTROL fully cw and LEVELING to UNLEV.

c. Observe the low band (0.01-2.0 GHz) on the network analyzer. Note the maximum output power level. Slowly adjust R114 on the master board ccw until the displayed signal starts to decrease in level.

d. Turn the adjustment screw of R114 two turns cw. Set LEVEL CONTROL fully ccw.

e. Adjust R115 until the low band output power is 16-17 dB below the maximum power level.

f. Repeat steps b. through e. as required, until the low unleveled power limit is 16-17 dB below the maximum power level.

8.6.2 High Band PIN Drive Bias Adjustment

a. On the Mainframe, set sweep mode at FULL BAND. On the Model 6608EDA, set LEVELING to UNLEV, LEVEL CONTROL to fully cw, and connect the RF output to the network analyzer.

b. Slowly rotate the LEVEL CONTROL ccw until the displayed low-band (0.01-2.0 GHz) output decreases 7 dB below its maximum level.

c. On the master board, adjust R143 to bring the high-band (2.0-4.2 GHz) display in line with the low-band display, as shown in Figure 8-5.

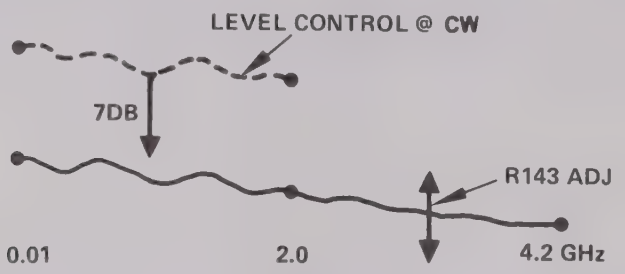


Figure 8-5. Unleveled Power Output Display.

8.6.3 Internal Level Loop Gain Adjustment

a. Set the oscilloscope controls as follows:

Vert	0.2 V/CM
Horiz	0.1 ms/CM
SYNC	INT

b. Set the sweeper controls as follows:

Sweep Mode	FULL BAND
LEVEL CONTROL	10 mW (as measured with a power meter)
LEVELING	INT

c. Connect a detector to the Model 6608EDA output port. On the scope, display the detected swept RF signal. Note the trace amplitude that corresponds to 10 mW cw signal.

d. On the Model 6600 Mainframe, set AM MODE rear-panel switch to INT SQ WAVE. On the scope, display the detected 1 kHz modulation as shown in Figure 8-6.

e. On the master board, adjust R76 until the rise overshoot is equal in level to the 10 mW power level, as shown above. As R76 is varied, the output level of the Model 6608EDA will change, requiring readjustment of the LEVEL CONTROL.

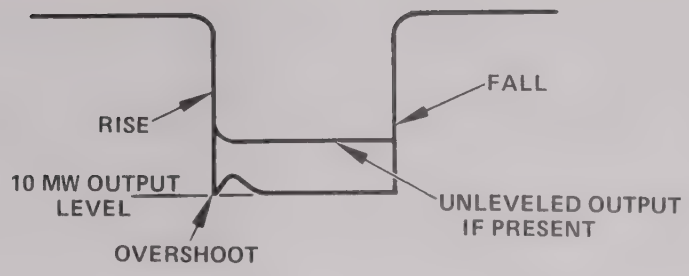


Figure 8-6. Desired Overshoot Response.

8.6.4 Rechecking PIN Drive Bias

a. Connect the scope probe to the emitter of Q37, at one end of 1W resistor R137, with scope's gain set at 2 V/cm and its horizontal sweep input obtained from the Model 6600 Mainframe. The Model 6608EDA is intenally leveled and at maximum output level.

b. Examine the waveform. If there are irregular "holes" in the low-band waveform, readjust pot R143 slightly in a ccw direction until the holes disappear, see Figure 8-7.

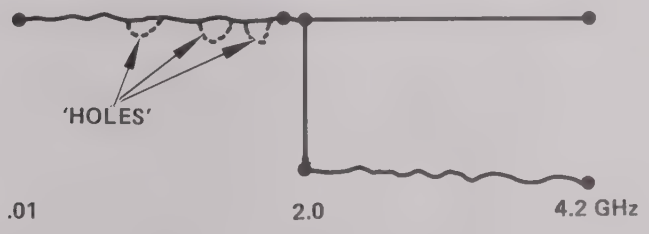


Figure 8-7. Voltage Display, Q37 Emitter.

8.6.5 Internal Level Sampler Slope

a. Connect the Model 6608EDA detected output to the network analyzer. Set network analyzer sensitivity to 0.5 dB/cm. Set Mainframe to FULL BAND sweep. Set plug-in LEVEL CONTROL to mid-range, and LEVELING to INT.

b. On the analyzer CRT, examine the displayed swept RF. The slope of the display shall be as horizontal as possible. Adjust R10 to achieve the best possible horizontal leveling.

8.6.6 "UNLEVELED WHEN LIT" Lamp Threshold Adjustment

a. Use the same test set-up connected in Paragraph 8.6.5 above. Turn LEVEL CONTROL fully clockwise, then back off slowly until complete RF leveling is displayed on the network analyzer.

b. Adjust R150 cw until the "UNLEVELED WHEN LIT" lamp goes on, then slowly back off on R150 until the lamp goes out.

8.6.7 FM Deviation Calibration

a. Connect Equipment as shown in Figure 8-8.

b. Switch Model 6600 sweep mode to cw and tune F_o control to 3 GHz. On the function generator, set controls for a 1 kHz sine wave 10 V peak-peak output. On the spectrum analyzer, set bandwidth at 100 kHz and scan width to 10 MHz/division.

c. On the master board, adjust R50 to obtain a 40 MHz display width on the spectrum analyzer.

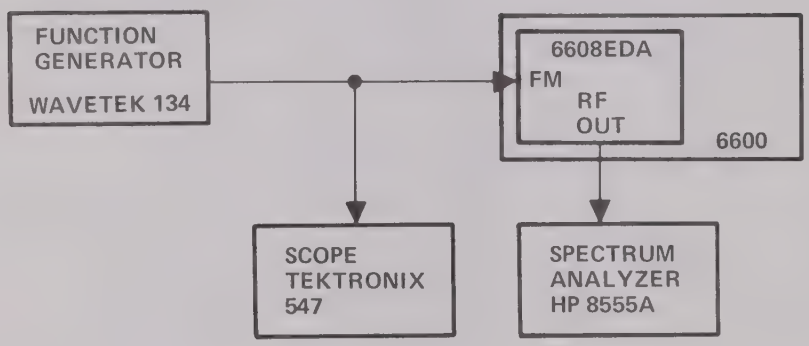


Figure 8-8. FM Deviation Calibration Equipment Setup.

8.6.8 NETWORK ANALYZER Output Drive Adjustment

a. Connect a digital voltmeter to the NTWK ANAL rear-panel jack of the Model 6608EDA.

b. With the Model 6600 in the cw sweep mode, tune the F_o control to 10 MHz.

c. On the Model 6608EDA, adjust R163 to obtain a reading of 0.1 volt ± 100 mV.

d. On the Model 6600, tune F_o control to 4.2 GHz.

e. On the Model 6608EDA, adjust R160 towards 42 volts.

NOTE

There is strong interaction between R160 and R163; to minimize the interaction, correct only one half the error with R160.

f. Repeat steps b. through e. as required, until the output drive ramp voltage end points of 0.1 V ± 100 mV and +42 V ± 100 mV are obtained.

8.6.9 2.2 GHz Oscillator Frequency Adjustment

a. Disconnect the 20 dB pad AT2 from PIN switch S2. See Figure 10-2 for location of these RF components.

b. Connect the output of 2.2 GHz oscillator Y2 through its 20 dB pad AT2 to a frequency counter.

c. On the frequency counter, monitor the oscillator frequency. The frequency shall be 2200 ± 5 MHz. If the output frequency requires correction, slowly adjust the trimmer capacitor located on the side wall of oscillator Y2 until 2200 ± 5 MHz is achieved.

NOTE

The 6608EDA plug-in unit under test should have been warmed up for 15 minutes or longer before oscillator frequency measurement and correction are attempted.

d. Reconnect the 20 dB pad AT2 to the PIN switch S2.

8.6.10 YIG Oscillator Frequency Limits Setting

a. Set the Model 6600 sweep mode to CW. On the Model 6602A Extender, connect a digital voltmeter between terminals F1 and REF GND. Connect a frequency counter through a 10 dB pad to the RF OUTPUT receptacle of the Model 6608EDA plug-in.

b. On the Mainframe, tune F_o control until the ramp tuning voltage monitored at F1 measures 0.000 V ± 2 mV.

c. On the 6608EDA master board, adjust R37 until a reading of 10.0 ± 2 MHz is obtained on the frequency counter. Be sure that the 10 MHz signal measured is above the '0' crossing.

NOTE

When adjusting tuning ramp, approach all voltages from the increasing direction, i.e., positive grade.

d. On the Model 6600, tune F_0 control until the measured ramp voltage at F1 reads 4.490 V ± 2 mV. Adjust pot R12 for a reading of 1900 ± 2 MHz on the frequency counter.

e. Repeat steps b. through d. until the frequencies are within the ±2 MHz tolerance.

f. Tune F_0 control until the measured ramp voltage at F1 reads 5.015 V ± 2 mV. On master board, adjust pot R41 for a reading of 2100 ± 2 MHz on the counter.

g. Tune F_0 control until the measured ramp voltage at F1 is 10.000 V ± 2 mV. Adjust R14 for a reading of 4200 ± 2 MHz on the counter.

h. Repeat steps f. and g. until the frequencies are within the ±2 MHz tolerance.

NOTE

The values of the voltages corresponding to 1.9 and 2.1 GHz were selected so as to produce an overlap at band change.

8.6.11 Band Change Frequency Adjustment

a. On the Mainframe, set sweep mode to M1→M2. Set marker M1 at 1.9 GHz and marker M2 at 2.1 GHz on the dial. Unblank the RF. On Model 6608EDA, set LEVELING to UNLVL.

b. Connect a frequency meter to the Model 6608EDA output, as shown in Figure 8-9. Display the detected output on the network analyzer.

c. Adjust R154 to set the higher frequency band changing point between 2020 and 2030 MHz. Note the power output level at the band change areas: fine-tune R154 as required to avoid the power rolloff exhibited by the S-band YIG oscillator at its low-end frequency limit.

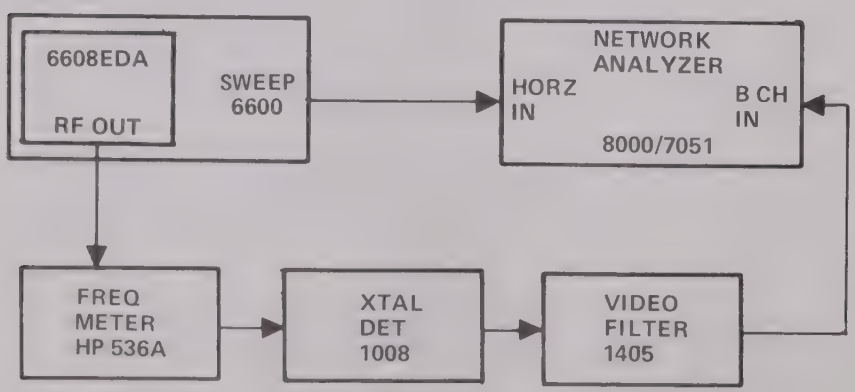


Figure 8-9. Equipment Setup for Band Change Frequency Adjustment.

8.6.12 Band Overlap Adjustment

a. Use equipment set-up shown in Figure 8-9.

b. Switch the plug-in leveling from UNLVL to INT.

c. Set the network analyzer sensitivity to 0.5 dB/cm.

d. Tune the frequency meter upward in frequency until the resonance dip, as seen on the network analyzer swept display, is split by the higher frequency band change mark, as shown in Figure 8-10a.

e. Tune the frequency meter downward in frequency by 5 MHz. Adjust R41 so that a second resonance dip of the frequency meter is split by the band change mark, as shown in Figure 8-10b.

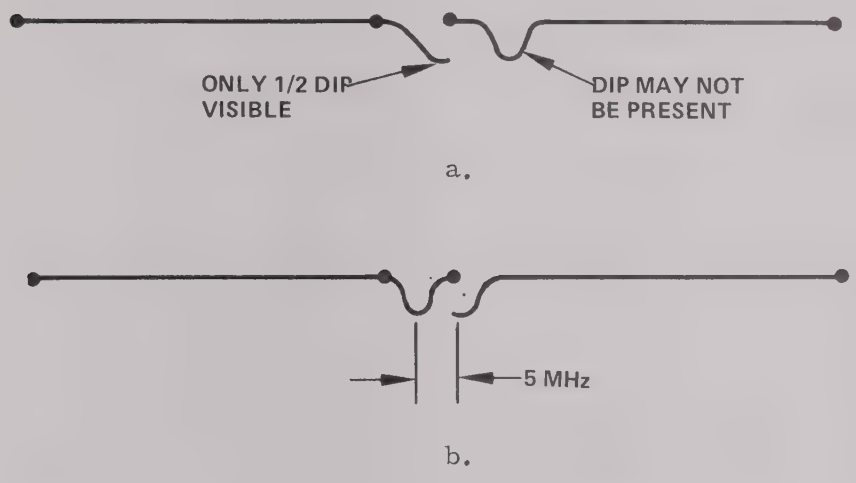


Figure 8-10. Resonant Dip Display.

8.6.13 Temperature Compensation Adjustment

a. When the YIG oscillator has been replaced, the temperature compensation circuit should be readjusted. Preset R34 as indicated in Paragraph 8.5.4. With the sweeper turned off and its temperature stabilized at room (ambient) temperature, control its output, through a 10 dB pad, to a frequency counter.

b. Turn on the sweeper and warm-up for 10 minutes. Set its frequency to 200.00 MHz, as read on the counter. Record this reference frequency.

c. After an additional 15 minute warm-up period, record the output frequency. Note whether the frequency has increased or decreased.

   1. If the frequency has increased, connect jumper wire W1 on the Model 6608EDA master board to its terminal marked "+". Likewise, connect jumper W2 to its "+" terminal.

   2. If the frequency has drifted downward, connect jumper W1 to its terminal marked "-". Likewise, connect jumper W2 to its "-" terminal.

d. Turn off the sweeper. Remove the Model 6608EDA plug-in and the Model 6602A Extender from the test set-up.

e. On the master board, connect a digital voltmeter between TP2 and reference ground TP5. The leads from the master board test points to the DVM terminals shall be sufficiently long to enable plugging the Model 6608EDA into the Model 6600 Mainframe with all its covers in place.

f. Warm-up the sweeper for 10 minutes, then record the output frequency and the voltage at TP2.

g. Allow the sweeper to operate 20-30 minutes, then, again, record the output frequency and the TP2 voltage.

h. Briefly, turn off the sweeper. Remove the Model 6608EDA plug-in. Install the Model 6602A Extender into the mainframe and plug the Model 6608EDA into the extender. Turn the sweeper on again.

i. Normalize the temperature compensation offset voltage by adjusting R30 for 0.0 ± 0.1 V at TP2, as read on the DVM.

j. Using the data recorded in steps f. and g. calculate the Δfrequency and Δvoltage. From the Δf and ΔV data, calculate the number of turns required to adjust slope control R34. The formula is:

$$\text{No. of turns} = 0.7 \frac{\Delta f \text{ (in MHz)}}{\Delta V \text{ (in volts)}}$$

k. Adjust R34 cw per calculated number of turns. This completes the normal temperature compensation adjustment. In those cases where a tighter temperature compensation is desired, repeat the above procedure. Note that if for the second measurement interval the Δf shows that the frequency has changed its drift direction, the newly calculated number of turns for R34 will be in the ccw direction.

l. Remove the DVM leads from the Model 6608EDA master board. This completes the tuning and adjustments of the Model 6608EDA unit under test.

8.7 FAULT LOCATION

8.7.1 Troubleshooting Information

Paragraphs 8.7.2 through 8.7.6 lists some general types of electrical performance problems, and the corresponding circuitry areas that may be causing the problems. Detailed information, useful for fault location on an individual component basis, is given in Paragraphs 8.8 and 8.9.

8.7.2 Output Power Problems

a. Both High and Low Bands
   - Fuses F1, F2, F3, F4
   - Voltages from Model 6600 Mainframe
   - YIG voltage regulators Q12, Q13
   - YIG oscillator Y1
   - YIG tuning coil driver Q5
   - Isolator AT1
   - 4-port PIN switch S1
   - Sampler HY1
   - Logic U16, U17, U18

b. Low Band only
   - 2.2 GHz oscillator Y2
   - 2.2 GHz PIN switch S2
   - Mixer Z1
   - Preamplifier AR1
   - Power amplifier AR2
   - 4-port PIN switch S1
   - PIN drivers Q32, Q44
   - Logic U18
   - Band select gates Q1, Q3

c. High band only
   - 4-port PIN switch S1
   - PIN drivers Q37, Q41
   - Logic U18
   - Band select gates Q2, Q4

8.7.3 Leveling Problems

a. Both bands

Sampler HY1

Sampler amplifier U10, U11, U12

Sampler select gates Q17, Q19, Q21

Leveling loop amplifiers Q25, Q26

b. Low band only

2.2 GHz PIN switch S2

Logic U17, U18

Pin switch drivers Q32, Q41

c. High band only

4-port PIN switch S1

PIN switch driver Q37

Logic U17, U18

8.7.4 Output Level Control Problems

a. Leveled mode

Leveling loop adder U9

Modulation gate Q15

Logic U16

Relay K3

Front panel controls R4, S1

PIN driver bias R143

b. Unleveled mode

Unleveled control amplifier U13

Leveling loop adder U9

Relay K3

Front panel controls R4, S3

PIN driver bias R143

8.7.5 Frequency Control Problems

a. Frequency Calibration
   - Ramps F1, F2, F3 from Model 6600
   - Ramp adder U1, U2, U3
   - Band select gates Q1 - Q4
   - YIG tuning coil driver Q5
   - YIG oscillator Y1
   - CW Relay K1

b. Band Changing
   - Band select comparator U14
   - Logic U17, U18

c. Sweep stop tuning
   - Logic U19, U20

8.7.6 Modulation Problems

a. FM Modulation
   - FM coil driver Q10, Q11
   - YIG FM coil Y1

b. AM linear Modulation
   - Leveling loop adder U9

c. Marker
   - Mainframe Model 6600
   - Leveling loop adder U9

d. AM Pulse modulation and Blanking
   - Mainframe Model 6600
   - Modulation gate Q15
   - Logic U16, U17, U18
   - PIN switch drivers Q32, Q37, Q41, Q44
   - Leveling loop amplifier Q25, Q27

8.8 RF COMPONENTS DATA

8.8.1 Maintenance and Repair

The various RF components of the Model 6608EDA plug-in RF deck do not require any routine maintenance or adjustment.

Furthermore, faulty components are not considered to be field repairable and should be returned to the factory for repair or replacement.

8.8.2 RF Output Data

The outputs of the individual RF components, in terms of frequency and power level, are shown in Table 8-3. For component location and reference designation, see Figure 10-2.

TABLE 8-3. RF POWER LEVEL DATA

Output Of:	Output Frequency (GHz)	Power Level Nominal (dBm)
Y1	2.0 - 4.2	+17
AT1	2.0 - 4.2	+16
S1 - J3	2.0 - 4.2	+13
AT3	2.0 - 4.2	+10
Y2	2.2	+13
AT2	2.2	-7
J2	2.2	-20 to -9
Z1 - X	0.01 to 2.0	-32 to -21
FL2	0.01 to 2.0	-35 to -24
AT5	0.01 to 2.0	-38 to -27
AR1 - J2	0.01 to 2.0	-17 to -6
AR2 - J2	0.01 to 2.0	+4 to +15
S1 - J2	0.01 to 4.2	+2 to +13
HY1 - J1	0.01 to 4.2	-1 to +10

8.9 DC VOLTAGES

8.9.1 Typical DC Voltages

Table 8-4 tabulates the typical dc voltages to be found at the various transistors and integrated circuits under the listed conditions of operation. These voltages are representative of those found when Model 6608EDA plug-in is operated as a single-frequency (CW mode) signal generated.

8.9.2 Typical Power Supply Currents

Table 8-5 tabulates the dc current flowing through each of the voltage distribution points of the Model 6608EDA plug-in. The listed currents are representative of those found when the instrument is operated as a single-frequency (CW mode) 4.0 GHz signal generator. For location of the voltage distribution points on the master board, see Figures 10-1 and 10-2. Current measurements can be made by unsoldering a choke from the master board or a wire on the RF deck.

TABLE 8-4. TYPICAL DC VOLTAGES

Component			Conditions							
Reference Designation	Pin	DC Voltage	Linear Change with CW Frequency	Low Band	High Band	Changes with Level Control	Internally Leveled	Unleveled	Externally Leveled (+)	Externally Leveled (-)
Q1	S	0 to +10.0	X							
	D	0 to +4.7	X	X						
		+4.2 to +8.8	X		X					
	G	0 to +4.5	X	X						
		+19			X					
Q2	S	0 to +10.0	X							
	D	0 to +4.2	X	X						
		+4.8 to +10	X		X					
	G	+19		X						
		+4.6 to +9.8	X		X					
Q3	S	+10.5								
	D	+10.4		X						
		+4.8			X					
	G	+10.1		X						
		+19			X					
Q4	S	+10.5								
	D	+7.6		X						
		+10.4			X					
	G	+19		X						
		+10.1			X					
Q5	E	-2.7 to -5.2	X	X						
		-2.4 to -5.2	X		X					
	B	-3.9 to -6.4	X	X						
		-3.6 to -6.4	X		X					
	C	-17.2 to -14.5	X	X						
		-17.4 to -14.5	X		X					
Q6	S	0								
	D	0								
	G	0		X						
		+19			X					
Q7	S	0								
	D	0								
	G	+19		X						
		0			X					
Q8	E	0								
	B	+0.7		X						
		+0.05			X					
	C	+0.05		X						
		+19			X					
Q9	E	0								
	B	+0.05		X						
		+0.7			X					
	C	+19		X						
		+0.05			X					
Q10	E	+0.05								
	B	+0.6								
	C	+20								
Q11	E	-0.05								
	B	-0.6								
	C	-20								
Q12	E	+15.1								
	B	+15.7								
	C	+20								
Q13	E	+7 to +15	X	X	X					
	B	+7.7 to +15.7	X	X	X					
	C	+20								
Q14	S	0 to +0.5	X							
	D	0 to +0.5	X				X			
		0						X		
	G	0 to +0.3	X				X			
		-10.3						X		
Q15	S	-0.2 to -1.3				X				
	D	-0.2 to -1.3				X				
	G	-0.2 to -1.3				X				

(Continued next page)

(Table 8-4, continued)

Component			Conditions							
Reference Designation	Pin	DC Voltage	Linear Change with CW Frequency	Low Band	High Band	Changes with Level Control	Internally Leveled	Unleveled	Externally Leveled (+)	Externally Leveled (-)
Q16	E	+0.7								
	B	0								
	C	+0.7								
Q17	S	-0.2 to -1.2				X	X			
	D	-0.2 to -1.2				X	X			
	G	-0.2 to -1.2				X	X			
		-10.4						X		
Q18	E	0.7					X			
		0						X		
	B	0								
	C	0.7					X			
		-10.8						X		
Q19	S	0								
	D	-0.2 to -1.2				X	X			
		0								X
	G	-10.5					X			
		0								X
Q20	E	0					X			
		+0.7								X
	B	0								
	C	-10.8					X			
		+0.7								X
Q21	S	0								
	D	-0.2 to -1.2				X	X			
		0							X	
	G	-10.5					X			
		0							X	
Q22	E	0					X			
		+0.7							X	
	B	0								
	C	-10.8					X			
		+0.7							X	
Q23	E	+0.5 to -0.6				X				
	B	-0.2 to -1.3				X				
	C	-11								
Q24	E	+1.0 to +0.1				X	X			
	B	+1.6 to +0.7				X	X			
	C	+18.9 to +18.6				X	X			
Q25	E	+18.9 to +18.6				X	X			
	B	+18.9 to +18.6				X	X			
	C	+1.0 to +7				X	X			
Q26	E	-0.1 to -1.0				X	X			
	B	-0.7 to -1.6				X	X			
	C	-10.0 to -10.4				X	X			
Q27	E	-10.7 to -10.9				X	X			
	B	-10.0 to -10.4				X	X			
	C	-1.2 to +5				X	X			
Q28	E	+5		(PWR MTR LVL SW OFF)						
		0		(PWR MTR LVL SW ON)						
	B	0					X			
		2.4							X	
	C	+20					X			
		+0.1		(PWR MTR LVL SW ON)					X	
Q29	E	0								
	B	0					X			
		+0.7						X		
	C	+20					X			
		+0.1						X		
Q30	E	-0.5 to +4.5				X	X			
		-0.9 to +2				X		X		
	B	+0.1 to +5.2				X	X			
		-0.3 to +2.3				X		X		
	C	+20								

(Continued next page)

(Table 8-4, continued)

Component			Conditions							
Reference Designation	Pin	DC Voltage	Linear Change with CW Frequency	Low Band	High Band	Changes with Level Control	Internally Leveled	Unleveled	Externally Leveled (+)	Externally Leveled (-)
Q31	E	+0.05		X						
		+0.6			X					
	B	0								
	C	-11		X						
		-10.4			X					
Q32	E	-2.2 to -0.6		X		X				
		-4.8			X					
	B	-1.7 to -0.1		X		X				
		-11			X					
	C	+5								
Q33	E	-11								
	B	-11		X						
		-10.4			X					
	C	-1.7 to -0.1		X		X				
		-11			X					
Q34	E	+16.8		X						
		+20			X					
	B	+16.1		X						
		+20			X					
	C	+10 to +8		X		X				
		-0.5 to -3			X	X				
Q35	E	+1.2		X						
		0			X					
	B	+1.8		X						
		+0.02			X					
	C	+16.1		X						
		+20			X					
Q36	E	+11 to +14				X				
	B	+11 to +13				X				
	C	+10 to +7		X		X				
		-0.5 to -3			X	X				
Q37	E	+4.5		X						
		0 to -2			X	X				
	B	+10 to +8		X		X				
		-0.5 to -3			X	X				
	C	-11		X						
		-8 to -7			X	X				
Q38	E	+20								
	B	+20, +19.1				X	X			
		+19.1						X		
	C	+0.1, +20				X	X			
		+20						X		
Q39A	E	+2.5, +3.4				X	X			
		+2.5						X		
	B	-0.6 to +4.1				X	X			
		-0.8 to 1.8				X		X		
	C	+20, +19.1				X	X			
		+19.1						X		
Q39B	E	+2.5, +3.4				X	X			
		+2.5						X		
	B	+3.2								
	C	+2.0								
Q40	E	-5.9		X						
		+4.3			X					
	B	+4.4		X						
		-3.6			X					
	C	+4.9		X						
		+4.3			X					
Q41	E	+5								
	B	+4.9		X						
		+4.3			X					
	C	-5.9		X						
		+4.3			X					

(Continued next page)

(Table 8-4, continued)

Component			Conditions							
Reference Designation	Pin	DC Voltage	Linear Change with CW Frequency	Low Band	High Band	Changes with Level Control	Internally Leveled	Unleveled	Externally Leveled (+)	Externally Leveled (-)
Q42	E	+0.6		X						
		+0.05			X					
	B	0								
	C	-9.8		X						
		-11			X					
Q43	E	-10.5		X						
		-11			X					
	B	-9.8		X						
		-11			X					
	C	-10.5		X						
		+4.3			X					
Q44	E	-11								
	B	-10.5		X						
		-11			X					
	C	-10.5		X						
		+4.3			X					
Q45	E	0								
	B	+0.02								
	C	+0.6								
Q46	E	-4.4								
	B	-3.8								
	C	+0.6 to +42.6	X							
Q47	E	+0.1 to +42.0	X							
	B	+0.6 to +42.6	X							
	C	+62								
U1	2	0								
	3	0								
	6	0								
U2	2	0 to +10.0	X							
	3	0 to +10.0	X							
	6	0 to +10.0	X							
U3	2	0 to +5	X							
	3	0 to +5	X							
	6	0 to +10.0	X							
U4	2	+0.5								
	3	+0.5								
	6	+0.1			(Changes with Temperature)					
U5	2	0								
	3	0								
	6	-3.9 to -6.4	X	X						
		-3.6 to -6.4	X		X					
U6	2	0								
	3	0								
	6	0								
U7	2	0								
	3	0								
	6	+15.7								
U8	2	0								
	3	0								
	6	-7.7 to -15.7	X	X	X					
U9	2	0								
	3	0								
	6	-0.2 to -1.3				X				
U10	2	-0.2 to -1.6				X	X			
	3	-0.2 to -1.6				X	X			
	6	-0.2 to -1.6				X	X			
U11	2	0								
	3	0								
	6	0								

(Continued next page)

(Table 8-4, continued)

Component			Conditions							
Reference Designation	Pin	DC Voltage	Linear Change with CW Frequency	Low Band	High Band	Changes with Level Control	Internally Leveled	Unleveled	Externally Leveled (+)	Externally Leveled (-)
U12	2	0								
	3	0								
	6	0								
U13	2	0								
	3	0								
	6	-0.3 to +2.3				X		X		
U14	2	0 to +10.0	X							
	3	+4.7								
	6	+17		X						
		-9			X					
U15	2	0								
	3	0								
	6	-10.6 to -6.4	X							
U16	1	+4.9								
	2	+4.9								
	4	+4.9								
	5	+4.9								
	6	+0.1								
	8	+3.5								
	9	+0.1								
	10	+4.9								
	12	+4.9								
	13	+4.9								
U17	8	+3.5		X						
		+0.1			X					
	9	+4.9								
	10	+3.5		X						
		+0.1			X					
	11	+3.5		X						
		+0.1			X					
	12	+3.5		X						
		+0.1			X					
	13	+4.9								
U18	1	+3.5								
	2	+3.5		X						
		+0.1			X					
	3	+0.1		X						
		+3.5			X					
	4	+3.5								
	5	+0.1		X						
		+3.5			X					
	6	+3.5		X						
		+0.1			X					
	8	+0.1		X						
		+3.5			X					
	9	+5.7		X						
		-0.6			X					
	10	+5.7		X						
		-0.6			X					
	11	+3.5		X						
		+0.1			X					
	12	+0.1		X						
		+3.5			X					
	13	+0.1		X						
		+3.5			X					
U19	1	+2.8								
	2	+2.8								
	3	+0.1								
	4	+4.0								
	5	+4.9								
	6	+0.1								
	8	+3.5								
	9	+0.1								
	10	+0.1								
	11	+3.5								
	12	+0.1								
	13	+4.9								

(Continued next page)

(Table 8-4, concluded)

Component			Conditions							
Reference Designation	Pin	DC Voltage	Linear Change with CW Frequency	Low Band	High Band	Changes with Level Control	Internally Leveled	Unleveled	Externally Leveled (+)	Externally Leveled (-)
U20	1	+3.5								
	2	+4.9								
	3	+4.9								
	4	+4.0								
	6	+1.7								
	7	+1.5								
	9	+3.5								
	10	+4.9								
	11	+4.9								
	12	+4.9								
	14	+1.7								
	15	+1.4								

TABLE 8-5. POWER SUPPLY CURRENTS

Voltage Distribution Point	Current (mA)	User
+20 V_1	10	
+20 V_2	16	
+20 V_3	25	
+20 V_4	80	
+20 V_5	70	Y_1 YIG regulators
+20 V_5	30	Y_1 YIG heater
+20 V_5	58	AR1 preamplifier
+20 V_5	190	AR2 power amplifier
-20 V_1	3	
-20 V_2	16	
-20 V_3	5	
-20 V_3	30	Y_2 2.26 Hz oscillator
-20 V_3	200	Y_1 YIG tuning
+5 V_1	85	
+5 V_2	100	
-11 V_1	13	
-11 V_2	15	
-11 V_3	7	
-11 V_4	108	
-11 V_5	6	

SECTION IX
REPLACEABLE PARTS

9.1 INTRODUCTION

This section includes all pertinent data necessary to locate, identify, and procure additional parts for the equipment. Parts are listed alpha-numerically by reference symbol and include all replaceable electronic items. Satisfactory replacement may be made with either the listed component or an exact replacement for the part(s) removed from the equipment.

9.2 ORDERING INFORMATION

The following instructions will aid in ordering parts.

a. Address all inquiries or orders to:

CUSTOMER SERVICE
Singer Instrumentation
5340 Alla Road
Los Angeles, California 90016

b. Include the following information:

(1) Model and Serial Number of instrument.
(2) Singer Part Number.
(3) Reference Designation.
(4) Description (as shown on Parts List).

9.3 PARTS LIST USE

The Table of Contents at the front of the manual lists the Parts List tables, related assemblies and location. The following paragraphs describe the use and meaning of the five columns included in the Parts Lists starting with Table 9-4.

a. Reference Designation, Column 1

The Reference Designation column contains an alphanumeric listing of parts as they appear on the equipment chassis, illustration, or schematic. The reference designation identifies the parts as to their component function in the instrument. Refer to Table 9-2 for reference designators.

b. Singer Part Number, Column 2

The Singer Part Number column contains the part number as designated by the Singer Company.

c. Description, Column 3

The Description column contains the identification of component parts, including all pertinent specifications. When the description column is used for a reference symbol for which no part exists, "Not Used" is placed in the column. In these instances, columns 2, 4 and 5 are left blank. Refer to Table 9-3 on abbreviations that are used in the parts lists.

d. Manufacturer's Code Number, Column 4

The Manufacturer's Code Number column references the manufacturer by an assigned code number, as listed in Federal Supply Code Handbook H4-2. For manufacturers not listed in the Handbook, a letter code will be assigned. Table 9-1 includes the manufacturer and his code designation.

e. Manufacturer's Part Number, Column 5

The Manufacturer's Part Number shown contains the part number as designated by the manufacturer of the part.

TABLE 9-1. CODE LIST OF MANUFACTURERS

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbook H4-2.

Code No.	Manufacturer	Address
00434	Schweber Electronics	Westbury, N.Y.
00656	Aerovox Corp.	New Bedford, Mass.
01121	Allen-Bradley Co.	Milwaukee, Wis.
01295	Texas Instruments, Inc., Transistor Products Div.	Dallas, Texas
02114	Ferroxcube Corp.	Saugerties, N.Y.
02735	RCA Semiconductor and Materials Div.	Sommerville, N.J.
03508	G.E. Semiconductor Products Div.	Syracuse, N.Y.
04062	Elmenco Products Co.	New York, N.Y.
04713	Motorola Inc., Semiconductor Products Div.	Phoenix, Ariz.
04946	Standard Wire and Cable Co.	Los Angeles, Calif.
07263	Fairchild Semiconductor Corp.	Mountain View, Calif.
07397	Sylvania Electronics Products, Inc.	Mountain View, Calif.
09353	C and K Components, Inc.	Watertown, Mass.
10133	Buss Machine Works, Inc.	Holland, Mich.
12300	Potter and Brumfield	Ontario, Calif.
12954	Dickson Electronics Corp.	Scottsdale, Ariz.
14674	Corning Glass Works, Electronic Components Div.	Corning, N.Y.
14752	Electro Cube	San Gabriel, Calif.
16508	Aerovox Corp., AVX Ceramic Div.	Myrtle Beach, S.C.
17856	Siliconix, Inc.	Santa Clara, Calif.
18324	Signetics Corp.	Sunnyvale, Calif.
21604	Buckeye Stamping Co.	Columbus, Ohio
24602	EMC Technology, Inc.	Philadelphia, Penn.
26805	American Microwave Industries, Inc.	Waltham, Mass.

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(Table 9-1, concluded)

Code No.	Manufacturer	Address
27014	National Semiconductor Corp.	Santa Clara, Calif.
28520	Heyman Mfg. Co.	Kenilworth, N.J.
29832	Teledyne Philbrick	Dedham, Mass.
31918	International Electro Exchange, Inc.	Prairie, Maine
32293	Intersil, Inc.	Cupertino, Calif.
56289	Sprague Electric Co.	North Adams, Mass.
72982	Erie Technological Products, Inc.	Erie, Penn.
75042	TRW Electronic Components	Philadelphia, Penn.
76433	General Instrument Corp.	Newark, N.J.
80294	Bourns, Inc.	Riverside, Calif.
88245	Litton Precision Products	Van Nuys, Calif.
88869	Singer Instrumentation	Los Angeles, Calif.
91506	Augat, Inc.	Attleboro, Mass.
91637	Dale Electronics, Inc.	Columbus, Neb.
91737	Gremar Mfg. Co.	Woburn, Mass.
97574	ITT Export Corp.	New York, N.Y.
98291	Sealectro Corp.	Mamaroneck, N.Y.

TABLE 9-2. REFERENCE DESIGNATORS

A	Assembly	P	Plug, Connector
AR	Amplifier	Q	Transistor
AT	Attenuator/Isolator	R	Resistor
C	Capacitor	RT	Thermistor
CP	Adapter	S	Switch
CR	Diode	T	Transformer
DS	Lamp	U	Integrated Circuit
F	Fuse	W	Cable
FL	Filter	Y	Crystal
J	Jack, Connector	Z	Miscellaneous Parts:
K	Relay		Ferrite Beads (RF Choke)
L	Inductor		Mixer Modulator

TABLE 9-3. ABBREVIATIONS

A	Ampere	%	± % if sign not shown
dc	Direct current	p	10^{-9}
Desig.	Designator	pF	Picofarad
k	Thousand	Ref.	Reference
m	0.001 (1/1000)	RF	Radio Frequency
mA	Milliampere	V	Volt
Mfr.	Manufacturer	W	Watts
No.	Number	μ	10^{-6}
		μF	Microfarads
		μH	Microhenry

TABLE 9-4. PARTS LIST FOR MAIN ASSEMBLIES

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
A1	4-005336-001	Assembly, Master Board	88869	
A2		Assembly, R.F. Deck		
A3		Assembly, Chassis and Switch Interconnect		

TABLE 9-5. PARTS LIST FOR MASTER BOARD ASSEMBLY, A1

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
C1	1-900098-035	Capacitor, fixed, mica, 150 pF, ±5%, 100 V dc	04062	DM5FA151J
C2	1-900098-035	Capacitor, fixed, mica, 150 pF, ±5%, 100 V dc	04062	DM5FA151J
C3	1-900098-035	Capacitor, fixed, mica, 150 pF, ±5%, 100 V dc	04062	DM5FA151J
C4	1-900098-035	Capacitor, fixed, mica, 150 pF, ±5%, 100 V dc	04062	DM5FA151J
C5	1-900098-017	Capacitor, fixed, mica, 30 pF, ±5%, 300 V dc	04062	DM5EC300J
C6	1-900076-001	Capacitor, fixed, ceramic, 0.01 µF, ±20%, 25 V dc	72982	5835-000-Y5U0-103Z
C7	1-900115-005	Capacitor, fixed, tantalum, 2.2 µF, ±20%, 15 V dc	12954	D2R2GS1D15M
C8	1-900039-004	Capacitor, fixed, electrolytic, 100 µF, -10% +75%, 25 V dc	76433	984-1653
C9	13-98	Capacitor, fixed, tantalum, 220 µF, ±20%, 10 V dc	56289	196P228X001TE4
C10	13-98	Capacitor, fixed, tantalum, 220 µF, ±20%, 10 V dc	56289	196P228X001TE4
C11	13-98	Capacitor, fixed, tantalum, 220 µF, ±20%, 10 V dc	56289	196P228X001TE4
C12	13-98	Capacitor, fixed, 220 µF, ±20%, 10 V dc	56289	196P228X001TE4
C13	1-900098-036	Capacitor, fixed, mica, 160 pF, ±5%, 100 V dc	04062	DM5FA161J
C14	1-900098-016	Capacitor, fixed, mica, 27 pF, ±5%, 300 V dc	04062	DM5EC270J
C15	(Used with assembly -002 only) 1-900098-016	Capacitor, fixed, mica, 27 pF, ±5%, 300 V dc	04062	DM5EC270J

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(Table 9-5, continued)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
C16	150-5025-001	Capacitor, fixed, tantalum, 33 µF, ±20%, 35 V dc	00434	T362D336M035AS
C17	(Used with assembly -002 only) 12-100	Capacitor, fixed, tantalum, 10 µF, ±20%, 35 V dc	97574	TAG-10/35-20
C18	12-100	Capacitor, fixed, tantalum, 10 µF, ±20%, 35 V dc	97574	TAG-10/35-20
C19	12-100	Capacitor, fixed, tantalum, 10 µF, ±20%, 35 V dc	97574	TAG-10/35-20
C20	12-100	Capacitor, fixed, tantalum, 10 µF, ±20%, 35 V dc	97574	TAG-10/35-20
C21	12-100	Capacitor, fixed, tantalum, 10 µF, ±20%, 35 V dc	97574	TAG-10/35-20
C22	12-100	Capacitor, fixed, tantalum, 10 µF, ±20%, 35 V dc	97574	TAG-10/35-20
C23	12-100	Capacitor, fixed, tantalum, 10 µF, ±20%, 35 V dc	97574	TAG-10/35-20
C24	12-100	Capacitor, fixed, tantalum, 10 µF, ±20%, 35 V dc	97574	TAG-10/35-20
C25	12-100	Capacitor, fixed, tantalum, 10 µF, ±20%, 35 V dc	97574	TAG-10/35-20
C26	12-100	Capacitor, fixed, tantalum, 10 µF, ±20%, 35 V dc	97574	TAG-10/35-20
C27	12-100	Capacitor, fixed, tantalum, 10 µF, ±20%, 35 V dc	97574	TAG-10/35-20

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(Table 9-5, continued)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
C28	12-100	Capacitor, fixed, tantalum, 10 µF, ±20%, 35 V dc	97574	TAG-10/35-20
C29	12-100	Capacitor, fixed, tantalum, 10 µF, ±20%, 35 V dc	97574	TAG-10/35-20
C30	12-100	Capacitor, fixed, tantalum, 10 µF, ±20%, 35 V dc	97574	TAG-10/35-20
C31	12-100	Capacitor, fixed, tantalum, 10 µF, ±20%, 35 V dc	97574	TAG-10/35-20
C32	12-100	Capacitor, fixed, tantalum, 10 µF, ±20%, 35 V dc	97574	TAG-10/35-20
C33	12-100	Capacitor, fixed, tantalum, 10 µF, ±20%, 35 V dc	97574	TAG-10/35-20
C34	12-100	Capacitor, fixed, tantalum, 10 µF, ±20%, 35 V dc	97574	TAG-10/35-20
C35	12-100	Capacitor, fixed, tantalum, 10 µF, ±20%, 35 V dc	97574	TAG-10/35-20
C36	12-100	Capacitor, fixed, tantalum, 10 µF, ±20%, 35 V dc	97574	TAG-10/35-20
C37	12-100	Capacitor, fixed, tantalum, 10 µF, ±20%, 35 V dc	97574	TAG-10/35-20
C38	1-900098-017	Capacitor, fixed, mica, 30 pF, ±5%, 300 V dc	04062	DM5EC300J
C39	1-900076-001	Capacitor, fixed, ceramic, 0.01 µF, ±20%, 25 V dc	72982	5835-000-Y5U0-103Z
C40	1-900098-017	Capacitor, fixed, mica, 30 pF, ±5%, 300 V dc	04062	DM5EC300J

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(Table 9-5, continued)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
C41	1-900098-031	Capacitor, fixed, mica, 100 pF, ±5%, 300 V dc	04062	DM5FC101J
C42	1-900098-016	Capacitor, fixed, mica, 27 pF, ±5%, 300 V dc	04062	DM5EC270J
C43	1-900118-114	Capacitor, fixed, mylar, 0.039 µF, ±5%, 400 V dc	14752	230D1E393-J
C44	12-100	Capacitor, fixed, tantalum, 10 µF, ±20%, 35 V dc	97574	TAG-10/35-20
C45	12-100	Capacitor, fixed, tantalum, 10 µF, ±20%, 35 V dc	97574	TAG-10/35-20
C46	1-900098-017	Capacitor, fixed, mica, 30 pF, ±5%, 300 V dc	04062	DM5EC300J
C47	1-900098-016	Capacitor, fixed, mica, 27 pF, ±5%, 300 V dc	04062	DM5EC270J
C48	12-100	Capacitor, fixed, tantalum, 10 µF, ±20%, 35 V dc	97574	TAG-10/35-20
C49	1-900098-026	Capacitor, fixed, mica, 62 pF, ±5%, 300 V dc	04062	DM5EC620J
C50	1-900122-031	Capacitor, fixed, ceramic, 0.0033 µF, ±10%, 100 V dc	00656	M39014/1-0446
C51	1-900122-031	Capacitor, fixed, ceramic, 0.0033 µF, ±10%, 100 V dc	00656	M39014/1-0446
C52	1-900076-001	Capacitor, fixed, ceramic, 0.01 µF, ±20%, 25 V dc	72982	5835-000-5YU0-103Z
C53	1-900098-031	Capacitor, fixed, mica, 100 pF, ±5%, 300 V dc	04062	DM5FC101J

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(Table 9-5, continued)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
C54	12-82	Capacitor, fixed, ceramic, 0.47 µF, ±20%, 100 V dc	88245	CY30A474M
C55	12-82	Capacitor, fixed, ceramic, 0.47 µF, ±20%, 100 V dc	88245	CY30A474M
C56	1-900104-007	Capacitor, fixed, ceramic, 1 µF, ±20%, 50 V dc	16508	3420-050E-105M
C57	12-100	Capacitor, fixed, tantalum, 10 µF, ±20%, 35 V dc	97574	TAG-10/35-20
C58	12-100	Capacitor, fixed, tantalum, 10 µF, ±20%, 35 V dc	97574	TAG-10/35-20
C59	1-900098-023	Capacitor, fixed, mica, 50 pF, ±5%, 300 V dc	04062	DM5EC500J
CR1	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR2	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR3	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR4	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR5	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR6	1-913007-001	Diode, silicon Vr = 75V, If = 10 mA	03508	1N4148
CR7	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR8	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR9	1-913001-002	Diode, silicon, Vr = 100V, If = 1 A	04713	1N4002

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(Table 9-5, continued)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
CR10	1-913004-020	Diode, zener, 20V, ±5%, 1W	04713	1N4747A
CR11	1-913001-002	Diode, silicon, Vr = 100 V, If = 1 A	04713	1N4002
CR12	1-913004-015	Diode, zener, 12V, ±5%, 1W	04713	1N4742A
CR13	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR14	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR15	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR16	1-913004-018	Diode, zener, 16V, ±5%, 1W	04713	1N4745A
CR17	(Used with assembly-002 only) 1-913004-018	Diode, zener, 16V, ±5%, 1W	04713	1N4745A
CR18	1-913004-021	Diode, zener, 22V, ±5%, 1W	04713	1N4748A
CR19	1-913004-021	Diode, zener, 22V, ±5%, 1W	04713	1N4748A
CR20	1-913004-007	Diode, zener, 5.6V, ±5%, 1W	04713	1N4734A
CR21	1-913004-016	Diode, zener, 13V, ±5%, 1W	04713	1N4743A
CR22	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR23	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR24	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR25	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR26	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148

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(Table 9-5, continued)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
CR27	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR28	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR29	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR30	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR31	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR32	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR33	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR34	1-913001-002	Diode, silicon, Vr = 100V, If = 1 A	04713	1N4002
CR35	1-913004-005	Diode, zener, 4.7V, ±5%, 1W	04713	1N4732A
CR36	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR37	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR38	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR39	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR40	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR41	1-913004-015	Diode, zener, 12V, ±5%, 1W	04713	1N4742A
CR42	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR43	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR44	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148

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(Table 9-5, continued)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
CR45	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR46	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR47	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR48	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR49	1-913058-002	Diode, germanium, Vr = 100V, If = 1 A	07397	1N277
CR50	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR51	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR52	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR53	1-913007-001	Diode, silicon, Vr = 75V, If = 10 mA	03508	1N4148
CR54	1-913001-002	Diode, silicon, Vr = 100V, If = 1 A	04713	1N4002
CR55	81-276	Diode, LED, 1.65V, 50 mA	50522	MV10B
F1	160-0008-001	Fuse, miniature, 1/2 A	10133	GMW 1/2 A
F2	160-0010-001	Fuse, miniature, 1 A	10133	GMW 1A
F3	160-0010-001	Fuse, miniature, 1 A	10133	GMW 1A
F4	160-0008-001	Fuse, miniature, 1/2 A	10133	GMW 1/2 A
J1	133-128	Connector, jack, 16 pin	91506	516-AG1D
J2	168-3003-001	Connector, jack, rt. angle snap-on	98291	51-053-0000
J3	168-3003-001	Connector, jack, rt. angle snap-on	98291	51-053-0000
J4	168-3003-001	Connector, jack, rt. angle snap-on	98291	51-053-0000
J5	168-3003-001	Connector, jack, rt. angle snap-on	98291	51-053-0000

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(Table 9-5, continued)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
J6	168-3003-001	Connector, jack, rt. angle snap-on	98291	51-053-0000
J7	168-3003-001	Connector, jack, rt. angle snap-on	98291	51-053-0000
J8	168-3003-001	Connector, jack, rt. angle snap-on	98291	51-053-0000
K1	106-61	Relay, 1 pole, 2 position, Coil: 28 V dc, 2 mA, 10 kilohm	12300	PW5LS-10K
K2	106-61	Relay, 1 pole, 2 position, Coil: 28 V dc, 2 mA, 10 kilohm	12300	PW5LS-10K
K3	106-61	Relay, 1 pole, 2 position, Coil: 28 V dc, 2 mA, 10 kilohm	12300	PW5LS-10K
L1	156-7005-002	Inductor, fixed, 750 ohm, ±20%, 50 MHz	02114	VK200 10/3B
L2	156-7005-002	Inductor, fixed, 750 ohm, ±20%, 50 MHz	02114	VK200 10/3B
L3	156-7005-002	Inductor, fixed, 750 ohm, ±20%, 50 MHz	02114	VK200 10/3B
L4	156-7005-002	Inductor, fixed, 750 ohm, ±20%, 50 MHz	02114	VK200 10/3B
L5	156-7005-002	Inductor, fixed, 750 ohm, ±20%, 50 MHz	02114	VK200 10/3B
L6	156-7005-002	Inductor, fixed, 750 ohm, ±20%, 50 MHz	02114	VK200 10/3B
L7	156-7005-002	Inductor, fixed, 750 ohm, ±20%, 50 MHz	02114	VK200 10/3B
L8	156-7005-002	Inductor, fixed, 750 ohm, ±20%, 50 MHz	02114	VK200 10/3B
L9	156-7005-002	Inductor, fixed, 750 ohm, ±20%, 50 MHz	02114	VK200 10/3B
L10	156-7005-002	Inductor, fixed, 750 ohm, ±20%, 50 MHz	02114	VK200 10/3B

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(Table 9-5, continued)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
L11	156-7005-002	Inductor, fixed, 750 ohm, ±20%, 50 MHz	02114	VK200 10/3B
L12	156-7005-002	Inductor, fixed, 750 ohm, ±20%, 50 MHz	02114	VK200 10/3B
L13	156-7005-002	Inductor, fixed, 750 ohm, ±20%, 50 MHz	02114	VK200 10/3B
L14	156-7005-002	Inductor, fixed, 750 ohm, ±20%, 50 MHz	02114	VK200 10/3B
L15	(Used with assembly -002 only) 156-7005-002	Inductor, fixed, 750 ohm, ±20%, 50 MHz	02114	VK200 10/3B
P1		Connector, 44 pin (Part of A1)		
Q1	153-4003-001	Transistor, P-channel, J-FET	17856	E-175
Q2	153-4003-001	Transistor, P-channel, J-FET	17856	E-175
Q3	153-4003-001	Transistor, P-channel, J-FET	17856	E-175
Q4	153-4003-001	Transistor, P-channel, J-FET	17856	E-175
Q5	81-294	Transistor, silicon, PNP	04713	MJE1092
Q6	153-4003-001	Transistor, P-channel J-FET	17856	E-175
Q7	153-4003-001	Transistor, P-channel J-FET	17856	E-175
Q8	1-958000-001	Transistor, silicon, NPN	04713	2N3904-5
Q9	1-958000-001	Transistor, silicon, NPN	04713	2N3904-5
Q10	153-5005-001	Transistor, silicon, NPN	02735	2N6178
Q11	153-5006-001	Transistor, silicon, PNP	02735	2N6180

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(Table 9-5, continued)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
Q12	153-5005-001	Transistor, silicon, NPN	02735	2N6178
Q13	(Used with assembly -002 only) 153-5005-001	Transistor, silicon, NPN	02735	2N6178
Q14	81-304	Transistor, N-channel, J-FET	17856	E-112
Q15	81-304	Transistor, N-channel, J-FET	17856	E-112
Q16	1-958000-002	Transistor, silicon, PNP	04713	2N3906-5
Q17	81-304	Transistor, N-channel, J-FET	17856	E-112
Q18	1-958000-002	Transistor, silicon, PNP	04713	2N3906-5
Q19	81-304	Transistor, N-channel, J-FET	17856	E-112
Q20	1-958000-002	Transistor, silicon, PNP	04713	2N3906-5
Q21	81-304	Transistor, N-channel, J-FET	17856	E-112
Q22	1-958000-002	Transistor, silicon, PNP	04713	2N3906-5
Q23	1-958000-002	Transistor, silicon, PNP	04713	2N3906-5
Q24	1-958000-001	Transistor, silicon, NPN	04713	2N3904-5
Q25	153-5006-001	Transistor, silicon, PNP	01121	2N6178
Q26	1-958000-002	Transistor, silicon, PNP	04713	2N3906-5
Q27	153-5005-001	Transistor, silicon, NPN	02735	2N6178
A28	1-958000-001	Transistor, silicon, NPN	04713	2N3904-5

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(Table 9-5, continued)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
Q29	1-958000-001	Transistor, silicon, NPN	04713	2N3904-5
Q30	1-958000-101	Transistor, silicon, NPN	04713	2N3904
Q31	1-958000-002	Transistor, silicon, PNP	04713	2N3906-5
Q32	153-0015-001	Transistor, silicon, NPN	04713	2N2219
Q33	1-958000-001	Transistor, silicon, NPN	04713	2N3904-5
Q34	1-958000-002	Transistor, silicon, PNP	04713	2N3906-5
Q35	1-958000-001	Transistor, silicon, NPN	04713	2N3904-5
Q36	1-958000-002	Transistor, silicon, PNP	04713	2N3906-5
Q37	81-103	Transistor, silicon, PNP	04713	2N3250
Q38	1-958000-002	Transistor, silicon, PNP	04713	2N3906-5
Q39	81-268	Transistor, silicon, NPN	32293	IT122
Q40	1-958000-002	Transistor, silicon, PNP	04713	2N3906-5
Q41	153-5006-001	Transistor, silicon, PNP	02735	2N6180
Q42	1-958000-002	Transistor, silicon, PNP	04713	2N3906-5
Q43	1-958000-001	Transistor, silicon, NPN	04713	2N3904-5
Q44	153-5005-001	Transistor, silicon, NPN	02735	2N6178
Q45	1-958000-001	Transistor, silicon, NPN	04713	2N3904-5
Q46	153-3033-001	Transistor, silicon, NPN	07263	MPS5551M

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(Table 9-5, continued)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
Q47	153-3033-001	Transistor, silicon, NPN	07263	MPS5551M
R1	1-945016-480	Resistor, fixed, film, 976 kilohm, ±1%, 1/4W	14674	RN60-D-9763F
R2	31-21K	Resistor, fixed, film, 21 kilohm, ±0.1%, 1/4W	14674	RN55-D-2102B
R3	1-945027-289	Resistor, fixed, film, 10 kilohm, ±1%, 1/8W	14674	RN55-D-1002F
R4	1-945027-416	Resistor, fixed, film, 210 kilohm, ±1%, 1/8W	14674	RN55-D-2103F
R5	31-21K	Resistor, fixed, film, 21 kilohm, ±0.1%, 1/4W	14674	RN55-D-2102B
R6	31-21K	Resistor, fixed, film, 21 kilohm, ±0.1%, 1/4W	19701	RN55-D-2102B
R7	1-945027-416	Resistor, fixed, film, 210 kilohm, ±1%, 1/8W	14674	RN55-D-2103F
R8	31-21K	Resistor, fixed, film, 21 kilohm, ±0.1%, 1/4W	19701	RN55-D-2102B
R9	1-945027-260	Resistor, fixed, film, 4.99 kilohm, ±1%, 1/8W	14674	RN55-D-4991F
R10	1-945056-007	Resistor, variable, wirewound, 1 kilohm, ±5%, 1W	80294	3255W-1-102
R11	1-945000-226	Resistor, fixed, composition, 470 kilohm, ±5%, 1/4W	01121	CB4745

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(Table 9-5, continued)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
R12	1-945056-007	Resistor, variable, wirewound, 1 kilohm, ±5%, 1/4W	80294	3255W-1-102
R13	1-945027-314	Resistor, fixed, film, selected, 18.2 kilohm nominal, ±1%, 1/8W	14674	RN55-D-1822F
R14	1-945056-007	Resistor, variable, wirewound, 1 kilohm, ±5%, 1W	80294	3255W-1-102
R15	1-945000-226	Resistor, fixed, composition, 470 kilohm, ±5%, 1/4W	01121	CB4745
R16	1-945027-320	Resistor, fixed, film, 21 kilohm, ±1%, 1/8W	14674	RN55-D-2102F
R17	1-945027-289	Resistor, fixed, film, 10 kilohm, ±1%, 1/8W	14674	RN55-D-1002F
R18	1-945080-003	Resistor, fixed, wirewound, 25 ohm, ±3%, 5W	91637	RN5-25R0-3%
R19	1-945000-130	Resistor, fixed, composition, 47 ohm, ±5%, 1/4W	01121	CB4705
R20	1-945000-138	Resistor, fixed, composition, 100 ohm, ±5%, 1/4W	01121	CB1015
R21	1-945027-289	Resistor, fixed, film, 10 kilohm, ±1%, 1/8W	14674	RN55-D-1002F
R22	1-945027-251	Resistor, fixed, film, 4.02 kilohm, ±1%, 1/8W	14674	RN55-D-4021F
R23	1-945027-243	Resistor, fixed, film, 3.32 kilohm, ±1%, 1/8W	14674	RN55-D-3321F
R24	1-945027-201	Resistor, fixed, film, selected, 1.21 kilohm nominal, ±1%, 1/8W	14674	RN55-D-1211F

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(Table 9-5, continued)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
R25	1-945027-230	Resistor, fixed, film, selected, 2.43 kilohm nominal, ±1%, 1/8W	14674	RN55-D-2431F
R26	1-945000-226	Resistor, fixed, composition, 470 kilohm, ±5%, 1/4W	01121	CB4745
R27	1-945000-226	Resistor, fixed, composition, 470 kilohm, ±5%, 1/4W	01121	CB4745
R28	1-945027-289	Resistor, fixed, film, 10 kilohm, ±1%, 1/8W	14674	RN55-D-1002F
R29	1-945027-289	Resistor, fixed, film, 10 kilohm, ±1%, 1/8W	14674	RN55-D-1002F
R30	1-945056-007	Resistor, variable, wirewound, 1 kilohm, ±5%, 1W	80294	3255W-1-102
R31	1-945027-356	Resistor, fixed, film, 49.9 kilohm, ±1%, 1/8W	14674	RN55-D-4992F
R32	1-945027-356	Resistor, fixed, film, 49.9 kilohm, ±1%, 1/8W	14674	RN55-D-4992F
R33	1-945016-481	Resistor, fixed, film, 1 megohm, ±1%, 1/4W	14674	RN60-D-1004F
R34	1-945056-009	Resistor, variable, wirewound, 5 kilohm, ±5%, 1W	80294	3255W-1-502
R35	1-945000-226	Resistor, fixed, composition, 470 kilohm, ±5%, 1/4W	01121	CB4745
R36	1-945000-226	Resistor, fixed, composition, 470 kilohm, ±5%, 1/4W	01121	CB4745
R37	1-945056-008	Resistor, variable, wirewound, 2 kilohm, ±5%, 1W	80294	3255W-1-202

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(Table 9-5, continued)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
R38	1-945027-230	Resistor, fixed, film, selected, 2.43 kilohm nominal, ±1%, 1/8W	14674	RN55-D-2431F
R39	1-945027-289	Resistor, fixed, film, 10 kilohm, ±1%, 1/8W	14674	RN55-D-1002F
R40	1-945027-293	Resistor, fixed, film, selected, 11 kilohm nominal, ±1%, 1/8W	14674	RN55-D-1102F
R41	1-945056-008	Resistor, variable, wirewound, 2 kilohm, ±5%, 1W	80294	3255W-1-202
R42	1-945027-414	Resistor, fixed, composition, 200 kilohm, ±1%, 1/8W	14674	RN55-D-2003F
R43	1-945000-182	Resistor, fixed, composition, 6.8 kilohm, ±5%, 1/4W	01121	CB6825
R44	1-945000-182	Resistor, fixed, composition, 6.8 kilohm, ±5%, 1/4W	01121	CB6825
R45	1-945000-174	Resistor, fixed, composition, 3.3 kilohm, ±5%, 1/4W	01121	CB3325
R46	1-945000-174	Resistor, fixed, composition, 3.3 kilohm, ±5%, 1/4W	01121	CB3325
R47	1-945000-174	Resistor, fixed, composition, 3.3 kilohm, ±5%, 1/4W	01121	CB3325
R48	1-945000-174	Resistor, fixed, composition, 3.3 kilohm, ±5%, 1/4W	01121	CB3325

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(Table 9-5, continued)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
R49	1-945027-218	Resistor, fixed, film, 1.82 kilohm, ±1%, 1/8W	14674	RN55-D-1812F
R50	1-945056-010	Resistor, variable, wirewound, 10 kilohm, ±5%, 1W	80294	3255W-1-103
R51	1-945027-260	Resistor, fixed, film, 4.99 kilohm, ±1%, 1/8W	14674	RN55-D-4991F
R52	1-945027-226	Resistor, fixed, film, 2.21 kilohm, ±1%, 1/8W	14674	RN55-D-2211F
R53	1-945000-178	Resistor, fixed, composition, 4.7 kilohm, ±5%, 1/4W	01121	CB4725
R54	1-945000-178	Resistor, fixed, composition, 4.7 kilohm, ±5%, 1/4W	01121	CB4725
R55	1-945001-114	Resistor, fixed, composition, 10 ohm, ±5%, 1/2W	01121	EB1005
R56	1-945001-114	Resistor, fixed, composition, 10 ohm, ±5%, 1/2W	01121	EB1005
R57	1-945000-178	Resistor, fixed, composition, 4.7 kilohm, ±5%, 1/4W	01121	CB4725
R58	1-945001-114	Resistor, fixed, composition, 10 ohm, ±5%, 1/2W	01121	EB1005
R59	1-945027-271	Resistor, fixed, film, 6.49 kilohm, ±1%, 1/8W	14674	RN55-D-6491F

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(Table 9-5, continued)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
R60	1-945027-290	Resistor, fixed, film, 10.2 kilohm, ±1%, 1/8W	14674	RN55-D-1022F
R61	(Used with assembly -002 only) 1-945027-289	Resistor, fixed, film, 10 kilohm, ±1%, 1/8W	14674	RN55-D-1002F
R62	(Used with assembly -002 only) 1-945027-193	Resistor, fixed, film, 1 kilohm, ±1%, 1/8W	14674	RN55-D-1001F
R63	(Used with assembly -002 only) 1-945027-210	Resistor, fixed, film, 1.5 kilohm, ±1%, 1/8W	14674	RN55-D-1501F
R64	(Used with assembly -002 only) 1-945027-193	Resistor, fixed, film, 1 kilohm, ±1%, 1/8W	14674	RN55-D-1001F
R65	(Used with assembly -002 only) 1-945027-289	Resistor, fixed, film, selected, 10 kilohm nominal, ±1%, 1/8W	14674	RN55-D-1002F
R66	(Used with assembly -002 only) 1-945027-306	Resistor, fixed, film, selected, 15 kilohm nominal, ±1%, 1/8W	14674	RN55-D-1502F
R67	(Used with assembly -002 only) 1-945027-210	Resistor, fixed, film, 1.5 kilohm, ±1%, 1/8W	14674	RN55-D-1501F
R68	1-945027-210	Resistor, fixed, film, 1.5 kilohm, ±1%, 1/8W	14674	RN55-D-1501F
R69	1-945027-324	Resistor, fixed, film, 23.2 kilohm, ±1%, 1/8W	14674	RN55-D-2322F

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(Table 9-5, continued)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
R70	1-945027-286	Resistor, fixed, film, 9.31 kilohm, ±1%, 1/8W	14674	RN55-D-9311F
R71	1-945027-285	Resistor, fixed, film, 9.09 kilohm, ±1%, 1/8W	14674	RN55-D-9091F
R72	1-945027-431	Resistor, fixed, film, 301 kilohm, ±1%, 1/8W	14674	RN55-D-3013F
R73	59-562K	Resistor, fixed, film, 562 kilohm, ±1%, 1/4W	19701	RN55-D-5623F
R74	59-562K	Resistor, fixed, film, 562 kilohm, ±1%, 1/4W	19701	RN55-D-5623F
R75	1-945027-431	Resistor, fixed, film, 301 kilohm, ±1%, 1/8W	14674	RN55-D-3013F
R76	1-945056-011	Resistor, variable, wirewound, 20 kilohm, ±5%, 1W	80294	3255W-1-203
R77	1-945027-297	Resistor, fixed, composition, 12.1 kilohm, ±1%, 1/8W	14674	RN55-D-1212F
R78	1-945027-289	Resistor, fixed, film 10 kilohm, ±1%, 1/8W	14674	RN55-D-1002F
R79	1-945000-226	Resistor, fixed, composition, 470 kilohm, ±5%, 1/4W	01121	CB4745

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(Table 9-5, continued)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
R80	1-945000-210	Resistor, fixed, composition, 100 kilohm, ±5%, 1/4W	01121	CB1045
R81	1-945000-182	Resistor, fixed, composition, 6.8 kilohm, ±5%, 1/4W	01121	CB6825
R82	1-945000-164	Resistor, fixed, composition, 1.2 kilohm, ±5%, 1/4W	01121	CB1225
R83	1-945000-226	Resistor, fixed, composition, 470 kilohm, ±5%, 1/4W	01121	CB4745
R84	1-945000-182	Resistor, fixed, composition, 6.8 kilohm, ±5%, 1/4W	01121	CB6825
R85	1-945000-168	Resistor, fixed, composition, 1.8 kilohm, ±5%, 1/4W	01121	CB1825
R86	1-945000-226	Resistor, fixed, composition, 470 kilohm, ±5%, 1/4W	01121	CB4745
R87	1-945027-231	Resistor, fixed, film, 2.49 kilohm, ±1%, 1/8W	14674	RN55-D-2491F
R88	1-945027-381	Resistor, fixed, film, 90.9 kilohm, ±1%, 1/8W	14674	RN55-9-9092F
R89	1-945000-226	Resistor, fixed, composition, 470 kilohm, ±5%, 1/4W	01121	CB4745
R90	1-945027-289	Resistor, fixed, film, 10 kilohm, ±1%, 1/8W	14674	RN55-D-1002F

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(Table 9-5, continued)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
R91	1-945000-182	Resistor, fixed, composition, 6.8 kilohm, ±5%, 1/4W	01121	CB6825
R92	1-945000-168	Resistor, fixed, composition, 1.8 kilohm, ±5%, 1/4W	01121	CB1825
R93	1-945027-260	Resistor, fixed, film, 4.99 kilohm, ±5%, 1/8W	14674	RN55-D-4991F
R94	1-945027-289	Resistor, fixed, film, 10 kilohm, ±1%, 1/8W	14674	RN55-D-1002F
R95	1-945000-226	Resistor, fixed, composition, 470 kilohm, ±5%, 1/4W	01121	CB4745
R96	1-945000-182	Resistor, fixed, composition, 6.8 kilohm, ±5%, 1/4W	01121	CB6825
R97	1-945000-168	Resistor, fixed, composition, 1.8 kilohm, ±5%, 1/4W	01121	CB1825
R98	1-945000-186	Resistor, fixed, composition, 10 kilohm, ±5%, 1/4W	01121	CB1035
R99	1-945000-178	Resistor, fixed, composition, 4.7 kilohm, ±5%, 1/4W	01121	CB4725
R100	1-945027-289	Resistor, fixed, film, 10 kilohm, ±1%, 1/8W	14674	RN55-D-1002F

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(Table 9-5, continued)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
R101	1-945000-145	Resistor, fixed, composition, 200 ohm, ±5%, 1/4W	01121	CB2015
R102	1-945001-131	Resistor, fixed, composition, 51 ohm, ±5% 1/2W	01121	EB5105
R103	1-945000-138	Resistor, fixed, composition, 100 ohm, ±5%, 1/4W	01121	CB1015
R104	1-945001-138	Resistor, fixed, composition, 100 ohm, ±5%, 1/2W	01121	EB1015
R105	1-945000-138	Resistor, fixed, composition, 100 ohm, ±5%, 1/4W	01121	CB1015
R106	1-945001-138	Resistor, fixed, composition, 100 ohm, ±5%, 1/2W	01121	EB1015
R107	1-945000-120	Resistor, fixed, composition, 18 ohm, ±5%, 1/4W	01121	CB1805
R108	1-945000-196	Resistor, fixed, composition, 27 kilohm, ±5%, 1/4W	01121	CB2735
R109	1-945027-264	Resistor, fixed, film, 5.49 kilohm, ±1%, 1/8W	14674	RN55-D-5491F
R110	1-945000-145	Resistor, fixed, composition, 200 ohm, ±5%, 1/4W	01121	CB2015

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(Table 9-5, continued)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
R111	1-945001-131	Resistor, fixed, composition, 51 ohm, ±5%, 1/2W	01121	EB5105
R112	1-945027-310	Resistor, fixed, film, 16.5 kilohm, ±1%, 1/8W	14674	RN55-D-1652F
R113	1-945027-306	Resistor, fixed, film, 15 kilohm, ±1%, 1/8W	14674	RN55-D-1502F
R114	1-945056-011	Resistor, variable, wirewound, 20 kilohm, ±5%, 1W	80294	3255W-1-203
R115	1-945056-013	Resistor, variable, wirewound, 50 kilohm, ±5%, 1W	80294	3255W-1-503
R116	1-945027-418	Resistor, fixed, film, 221 kilohm, ±1%, 1/8W	14674	RN55-D-2213F
R117	1-945027-356	Resistor, fixed, film, 49.9 kilohm, ±1%, 1/8W	14674	RN55-D-4992F
R118	1-945000-174	Resistor, fixed, composition, 3.3 kilohm, ±5%, 1/4W	01121	CB3325
R119	1-945000-174	Resistor, fixed, composition, 3.3 kilohm, ±5%, 1/4W	01121	CB3325
R120	1-945000-186	Resistor, fixed, composition, 10 kilohm, ±5%, 1/4W	01121	CB1035
R121	1-945000-174	Resistor, fixed, composition, 3.3 kilohm, ±5%, 1/4W	01121	CB3325

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(Table 9-5, continued)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
R122	1-945000-174	Resistor, fixed, composition, 3.3 kilohm, ±5%, 1/4W	01121	CB3325
R123	1-945000-186	Resistor, fixed, composition, 10 kilohm, ±5%, 1/4W	01121	CB1035
R124	1-945000-186	Resistor, fixed, composition, 10 kilohm, ±5%, 1/4W	01121	CB1035
R125	1-945000-170	Resistor, fixed, composition, 2.2 kilohm, ±5%, 1/4W	01121	CB2225
R126	1-945000-170	Resistor, fixed, composition, 2.2 kilohm, ±5%, 1/4W	01121	CB2225
R127	1-945000-170	Resistor, fixed, composition, 2.2 kilohm, ±5%, 1/4W	01121	CB2225
R128	1-945000-162	Resistor, fixed, composition, 1 kilohm, ±5%, 1/4W	01121	CB1025
R129	1-945001-147	Resistor, fixed, composition, 240 ohm, ±5%, 1/2W	01121	EB2415
R130	1-945000-144	Resistor, fixed, composition, 180 ohm, ±5%, 1/4W	01121	CB1815
R131	1-945000-138	Resistor, fixed, composition, 100 ohm, ±5%, 1/4W	01121	CB1015
R132	1-945000-138	Resistor, fixed, composition, 100 ohm, ±5%, 1/4W	01121	CB1015

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(Table 9-5, continued)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
R133	1-945000-174	Resistor, fixed, composition, 3.3 kilohm, ±5%, 1/4W	01121	CB3325
R134	1-945000-154	Resistor, fixed, composition, 470 ohm, ±5%, 1/4W	01121	CB4715
R135	1-945000-186	Resistor, fixed. composition, 10 kilohm, ±5%, 1/4W	01121	CB1035
R136	1-945000-166	Resistor, fixed, composition, 1.5 kilohm, ±5%, 1/4W	01121	CB1501F
R137	1-945002-162	Resistor, fixed, composition, 1 kilohm, ±5%, 1W	01121	GB1025
R138	1-945000-154	Resistor, fixed, composition, 470 ohm, ±5%, 1/4W	01121	CB4715
R139	1-945000-146	Resistor, fixed, composition, 220 ohm, ±1%, 1/4W	01121	CB2215
R140	1-945000-138	Resistor, fixed, composition, 100 ohm, ±5%, 1/4W	01121	CB1015
R141	1-945000-174	Resistor, fixed, composition, 3.3 kilohm, ±5%, 1/4W	01121	CB3325
R142	1-945000-162	Resistor, fixed, composition, 1 kilohm, ±5%, 1/4W	01121	CB1025
R143	1-945056-008	Resistor, variable, wirewound, 2 kilohm, ±5%, 1W	80294	3255W-1-202
R144	1-945002-136	Resistor, fixed, film, 82 ohm, ±5%, 1W	01121	GB8205
R145	1-945000-162	Resistor, fixed, composition, 1 kilohm, ±5%, 1/4W	01121	CB1025

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(Table 9-5, continued)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
R146	1-945000-138	Resistor, fixed, composition, 100 ohm, ±5%, 1/4W	01121	CB1015
R147	1-945027-226	Resistor, fixed, film, 2.21 kilohm, ±1%, 1/8W	14674	RN55-D-2211F
R148	1-945027-295	Resistor, fixed, film, 11.5 kilohm, ±1%, 1/8W	14674	RN55-D-1152F
R149	1-945027-243	Resistor, fixed, film, 3.32 kilohm, ±1%, 1/8W	14674	RN55-D-3321F
R150	1-945056-009	Resistor, variable, wirewound, 5 kilohm, ±5%, 1W	80294	3255W-1-502
R151	1-945000-170	Resistor, fixed, composition, 2.2 kilohm, ±5%, 1/4W	01121	CB2225
R152	1-945027-289	Resistor, fixed, film, 10 kilohm, ±1%, 1/8W	14674	RN55-D-1002F
R153	1-945027-277	Resistor, fixed, film, 7.5 kilohm, ±1%, 1/8W	14674	RN55-D-7501F
R154	1-945056-006	Resistor, variable, wirewound, 500 ohm, ±5%, 1W	80294	3255W-1-501
R155	1-945027-265	Resistor, fixed, film, 5.62 kilohm, ±1%, 1/8W	14674	RN55-D-5621F
R156	1-945027-255	Resistor, fixed, film, 4.42 kilohm, ±1%, 1/8W	14674	RN55-D-4421F
R157	1-945027-193	Resistor, fixed, film, 1 kilohm, ±1%, 1/8W	14674	RN55-D-1001F

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(Table 9-5, continued)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
R158	1-945027-272	Resistor, fixed, film, 6.65 kilohm, ±1%, 1/8W	14674	RN55-D-6651F
R159	1-945027-097	Resistor, fixed, film, 100 ohm, ±1%, 1/8W	14674	RN55-D-1000F
R160	1-945056-008	Resistor, variable, wirewound, 2 kilohm, ±5%, 1W	80294	3255W-1-202
R161	1-945027-315	Resistor, fixed, film, 18.7 kilohm, ±1%, 1/8W	14674	RN55-D-1872F
R162	1-945027-318	Resistor, fixed, film, 20 kilohm, ±1%, 1/8W	14674	RN55-D-2002F
R163	1-945056-008	Resistor, variable, wirewound, 2 kilohm, ±5%, 1W	80294	3255W-1-202
R164	1-945027-280	Resistor, fixed, film, 8.06 kilohm, ±1%, 1/8W	14674	RN55-D-8061F
R165	1-945027-210	Resistor, fixed, film, 1.5 kilohm, ±1%, 1/8W	14674	RN55-D-1501F
R166	1-945027-306	Resistor, fixed, film, 15 kilohm, ±1%, 1/8W	14674	RN55-D-1502F
R167	1-945027-226	Resistor, fixed, film, 2.21 kilohm, ±1% 1/8W	14674	RN55-D-2211F
R168	1-945027-253	Resistor, fixed, film, 4.22 kilohm, ±1%, 1/8W	14674	RN55-D-4221F
R169	1-945027-343	Resistor, fixed, film, 36.5 kilohm, ±1%, 1/8W	14674	RN55-D-3652F
R170	1-945027-318	Resistor, fixed, film, 20 kilohm, ±1%, 1/8W	14674	RN55-D-2002F

(Continued next page)

(Table 9-5, continued)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
R171	1-945000-178	Resistor, fixed, composition, 4.7 kilohm, ±5%, 1/4W	01121	CB4725
R172	1-945000-178	Resistor, fixed, composition, 4.7 kilohm, ±5%, 1/4W	01121	CB4725
R173	1-945000-178	Resistor, fixed, composition, 4.7 kilohm, ±5%, 1/4W	01121	CB4725
R174	1-945000-178	Resistor, fixed, composition, 4.7 kilohm, ±5%, 1/4W	00121	CB4725
R175	1-945000-186	Resistor, fixed, composition, 10 kilohm, ±5%, 1/4W	01121	CB1035
R176	1-945027-289	Resistor, fixed, film, 10 kilohm, ±1%, 1/8W	14674	RN55-D-1002F
R177	1-945027-300	Resistor, fixed, film, 13 kilohm, ±1%, 1/8W	14674	RN55-D-1302F
R178	1-945027-289	Resistor, fixed, film, 10 kilohm, ±1%, 1/8W	14674	RN55-D-1002F
R179	1-945027-300	Resistor, fixed, film, 13 kilohm, ±1%, 1/8W	14674	RN55-D-1302F
R180	1-945000-194	Resistor, fixed, composition, 22 kilohm, ±5%, 1/4W	01121	CB2235
R181	1-945000-170	Resistor, fixed, composition, 2.2 kilohm, ±5%, 1/4W	01121	CB2225

(Continued next page)

(Table 9-5, continued)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
R182	1-945000-182	Resistor, fixed, composition, 6.8 kilohm, ±5%, 1/4W	01121	CB6825
R183	1-945000-178	Resistor, fixed, composition, 4.7 kilohm, ±5%, 1/4W	01121	CB4725
R184	1-945000-170	Resistor, fixed, composition, 2.2 kilohm, ±5%, 1/4W	01121	CB2225
R185	1-945001-138	Resistor, fixed, composition, 100 ohm, ±5%, 1/2W	01121	EB1015
R186	1-945001-138	Resistor, fixed, composition, 100 ohm, ±5%, 1/2W	01121	EB1015
R187	1-945001-131	Resistor, fixed, composition, 51 ohm, ±5%, 1/2W	01121	EB5105
R188	1-945000-170	Resistor, fixed, composition, 2.2 kilohm, ±5%, 1/4W	01121	CB2225
R189	1-945000-178	Resistor, fixed, composition, 4.7 kilohm, ±5%, 1/4W	01121	CB4725
R190	1-945027-291	Resistor, fixed, film, 10.5 kilohm, ±1%, 1/8W	14674	RN55-D-1052F
R191	1-945000-186	Resistor, fixed, composition, 10 kilohm, ±5%, 1/4W	01121	CB1035
R192	1-945027-347	Resistor, fixed, film, 40.2 kilohm, ±1%, 1/8W	14674	RN55-D-4022F
R193	1-945000-186	Resistor, fixed, composition, 10 kilohm, ±5%, 1/4W	01121	CB1035

(Continued next page)

(Table 9-5, continued)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
R194	1-945000-174	Resistor, fixed, composition, 3.3 kilohm, ±5%, 1/4W	01121	CB3325
R195	1-945000-174	Resistor, fixed, composition, 3.3 kilohm, ±5%, 1/4W	01121	CB3325
R196	1-945027-349	Resistor, fixed, film, 42.2 kilohm, ±1%, 1/8W	14674	RN55-D-4222F
R197	1-945002-132	Resistor, fixed, composition, 56 ohm, ±5%, 1W	01121	GB5605
R198	1-945000-174	Resistor, fixed, composition, 3.3 kilohm, ±5%, 1/4W	01121	CB3325
R199	1-945002-162	Resistor, fixed, composition, 1 kilohm, ±5%, 1W	01121	GB1025
R200	1-945027-305	Resistor, fixed, film, 14.7 kilohm, ±1%, 1/8W	14674	RN55-D-1472F
R201	1-945000-194	Resistor, fixed, composition, 22 kilohm, ±5%, 1/4W	01121	CB2235
R202	1-945000-130	Resistor, fixed, composition, 47 ohm, ±5%, 1/4W	01121	CB4705
U1	152-7056-001	Integrated circuit, low noise op. amp.	29832	TP1319
U2	153-7056-001	Integrated circuit, low noise op. amp.	29832	TP1319
U3	153-7056-001	Integrated circuit, low noise op. amp.	29832	TP1319
U4	84-1	Integrated circuit, high performance op. amp.	18324	LM101A

(Contined next page)

(Table 9-5, continued)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
U5	153-7056-001	Integrated circuit, low noise op. amp.	29832	TP1319
U6	153-7057-001	Integrated circuit, op. amp.	27014	LM318
U7	84-1	Integrated circuit, high performance op. amp.	18324	LM101A
U8	(Used with assembly -002 only) 84-1	Integrated circuit, high performance op. amp.	18324	LM101A
U9	84-1	Integrated circuit, high performance op. amp.	18324	LM101A
U10	84-1	Integrated circuit, high performance op. amp.	18324	LM101A
U11	152-7057-001	Integrated circuit, op. amp.	27014	LM318
U12	84-1	Integrated circuit, high performance op. amp.	18324	LM101A
U13	84-1	Integrated circuit, high performance op. amp.	18324	LM101A
U14	84-1	Integrated circuit, high performance op. amp.	18324	LM101A
U15	84-1	Integrated circuit, high performance op. amp.	18324	LM101A
U16	1-926007-031	Integrated circuit, dual gate, 4-input, positive NAND	01295	SN7420N
U17	1-926007-030	Integrated circuit, dual gate, 2-input, positive AND	01295	SN7408N

(Continued next page)

(Table 9-5, concluded)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
U18	1-926007-001	Integrated circuit, quad gate, 2-input, positive NAND	01295	SN7400N
U19	1-926007-001	Integrated circuit, quad gate, 2-input, positive NAND	01295	SN7400N
U20	1-926007-007	Integrated circuit, dual monostable multivibrator, retriggerable	01295	SN74123N
W1	1-999001-007	Wire, 22 gauge buss, jumper	04946	QQ-W-343
W2	1-999001-007	Wire, 22 gauge buss, jumper	04946	QQ-W-343
W3		Not used		
W4	1-999001-007	Wire, 22 guage buss, jumper (normally omitted)	04946	QQ-W-343
Z1	169-1019-001	Bead, ferrite	02114	VK21107/313

TABLE 9-6. PARTS LIST FOR RF DECK ASSEMBLY, A2

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
AR1	4-005310-001	Pre-amplifier assembly	88869	
AR2	4-005311-001	Power amplifier assembly	88869	
AT1	1-403998-001	Attenuator, 2 GHz to 4.2 GHz isolator	88869	
AT2	159-8002-004	Attenuator, coaxial, 20 dB	24602	4420
AT3	159-8002-003	Attenuator, coaxial, 3 dB	24602	4403
AT4	159-8002-003	Attenuator, coaxial, 3 dB	24602	4403
AT5	159-8002-003	Attenuator, coaxial, 3 dB	24602	4403
CR1	1-913007-001	Diode, silicon VR=75V, If=10mA	03508	1N4148
CP1	168-4076-001	Connector, adaptor, SMA plug to SMA plug	26805	2081-0000
CP2	168-4076-001	Connector, adaptor, SMA plug to SMA plug	26805	2081-0000
FL1	103-2332-001	Filter, low pass, 3 GHz	88869	
FL2	103-2214-001	Filter, low pass 2 GHz	88869	
HY1	103-2282-001	Sampler, 0.1 GHz to 4 GHz	88869	
J1		Part of HY1		
S1	3-005320-001	PIN switch/leveler assembly	88869	
S2	103-2244-001	PIN switch assembly, 2.2 GHz	88869	
W1		Not used		
W2		Not used		
W3		Not used		

(Continued next page)

(Table 9-6, concluded)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
W4		Not used		
W5		Not used		
W6		Not used		
W7	1-005333-001	Cable assembly, coaxial, 17 in., SMB to SMC	88869	
W8	1-005333-002	Cable assembly, coaxial, 19 in., SMB to SMC	88869	
W9		Not used		
W10		Not used		
W11		Not used		
W12		Not used		
W13	2-005326-001	Cable assembly, semi-rigid, 2.9 in., SMA to SMA	88869	
W14	2-005327-001	Cable assembly, semi-rigid, 8.2 in., SMA to SMA	88869	
W15	2-005328-001	Cable assembly, semi-rigid, 3.5 in., SMA to SMA	88869	
W16	2-005329-001	Cable assembly, semi-rigid, 6.2 in., SMA to SMA	88869	
W17	2-005330-001	Cable assembly, semi-rigid, 4 in., SMA to SMA	88869	
W18	2-005331-001	Cable assembly, semi-rigid, 2.8 in., SMA to SMA	88869	
Y1	113-1019-001	Oscillator, 2 GHz to 4.2 GHz	88869	
Y2	103-2234-001	Oscillator, 2.2 GHz	88869	
Z1	103-2221-001	Mixer, doubly balanced	88869	

TABLE 9-7. PARTS LIST FOR CHASSIS AND SWITCH INTERCONNECT ASSEMBLY, A3

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
J1	133-128	Connector, jack, 16 pin	91506	516-AG1D
J2	131-33	Connector, jack, BNC	91737	UG-1094A/U
J3	131-33	Connector, jack, BNC	91737	UG-1094A/U
J4	131-33	Connector, jack, BNC	91737	UG-1094A/U
J5	131-33	Connector, jack, BNC	91737	UG-1094A/U
R1	1-945027-124	Resistor, fixed, film, 191 ohm, ±1%, 1/8 W	14674	RN55-D-1910F
R2	1-945000-147	Resistor, fixed, composition, 240 ohm, ±5%, 1/4 W	01121	CB2415
R3	71-93	Resistor, variable, cermet, 10 kilohm, ±10%, 3/4 W	75042	960-290-10K
R4A/ R4B	912-185	(R4A) resistor, variable, composition, 1 kilohm, ±10%, 1/2 W	88869	
R4B		Resistor, variable, composition, 1 kilohm, ±10%, 1/2 W (Part of R4A/R4B)		
S1/ S2/ S3	101-40	Triple pushbutton switch assembly (S1) switch, pushbutton, 2 pole, 2 position	31918	3XF12.5-2U-GR-D
S2		Switch, pushbutton, 2 pole, 2 position (Part of S1/S2/S3)		
S3		Switch, pushbutton, 2 pole, 2 position (Part of S1/S2/S3)		
S4	913-919	Switch, slide, 2 pole, 2 position		
S5	1-951036-001	Switch, toggle, 1 pole, 2 position	09353	7101

(Continued next page)

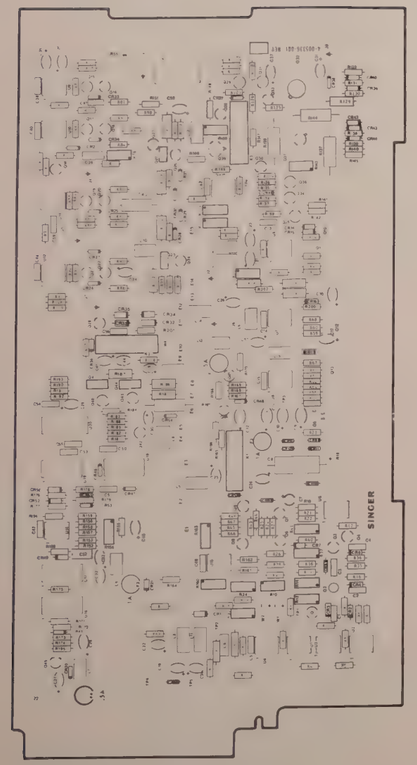
(Table 9-7, concluded)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
W1		Not used		
W2		Not used		
W3		Not used		
W4		Not used		
W5	1-005334-001	Cable assembly, coaxial, 10 in., SMC at one end	88869	
W6	1-005332-001	Cable assembly, flat ribbon, 6 in., 16 pin to 16 pin	88869	
W7		Not used		
W8		Not used		
W9	1-005334-002	Cable assembly, coaxial, 14 in., SMC at one end	88869	
W10	1-005334-003	Cable assembly, coaxial, 14 in., SMC at one end	88869	
W11	1-005334-004	Cable assembly, coaxial, 15 in., SMC at one end	88869	
W12	1-005334-005	Cable assembly, coaxial, 13 in., SMC at one end	88869	

TABLE 9-8. PARTS LIST – MISCELLANEOUS

Qty.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
1	170-5011-0512	Knob, round indicator	21604	RSS-50L-(L) 1/2 SCR
3	120-0132-001	Button, switch	88869	
2	341-23	Bushing, snap	28520	SB312-3

SECTION X
SCHEMATIC DIAGRAMS



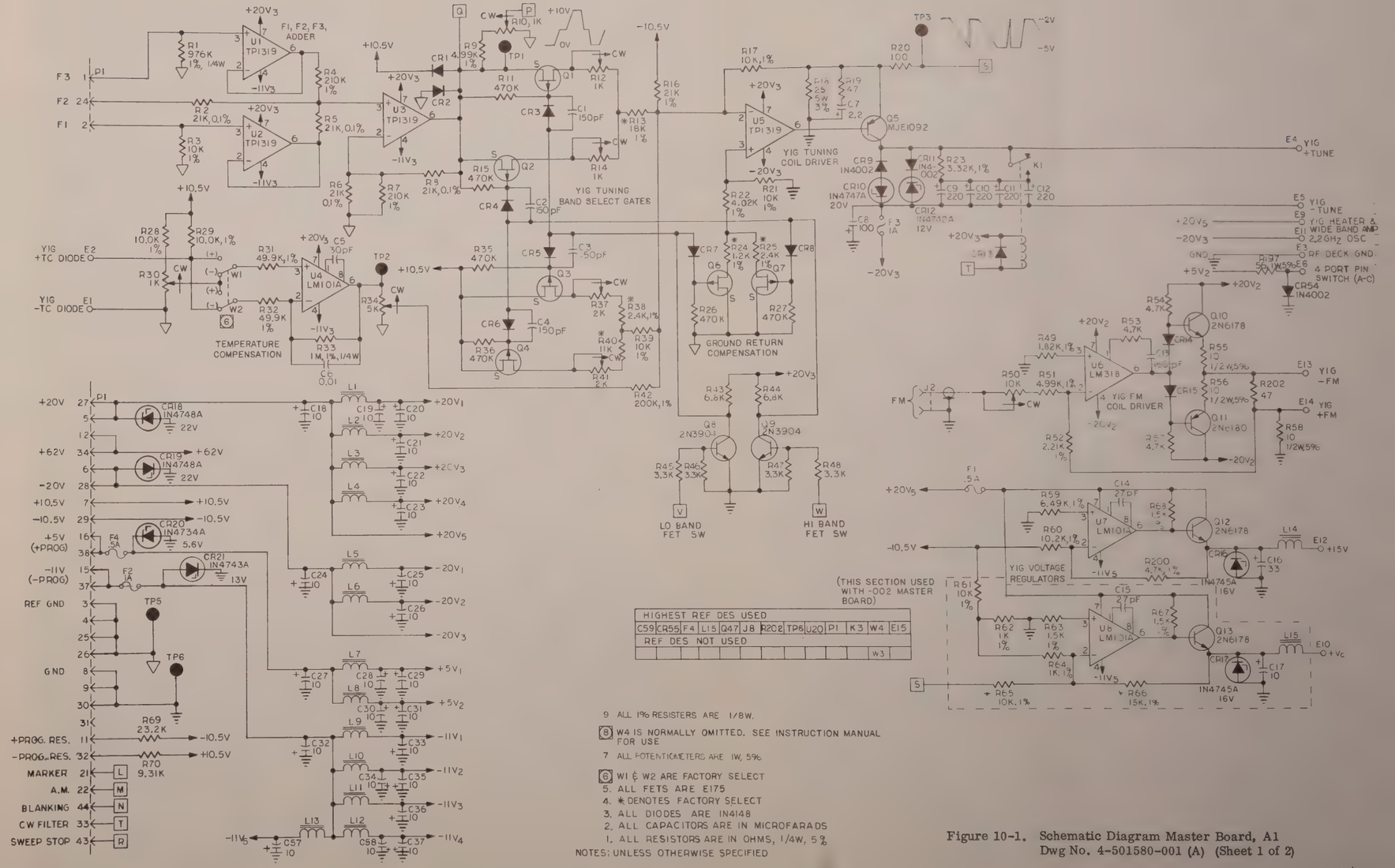

TEMPERATURE COMPENSATION
YIG TUNING BAND SELECT GATES
YIG TUNING COIL DRIVER
GROUND RETURN COMPENSATION
LO BAND FET SW
HI BAND FET SW
YIG VOLTAGE REGULATORS
YIG FM COIL DRIVER
(THIS SECTION USED WITH -002 MASTER BOARD)
4 PORT PIN SWITCH (A-C)
HIGHEST REF DES USED
C59 CR55 F4 L15 Q47 J8 R202 TP6 U20 P1 K3 W4 E15
REF DES NOT USED
W3
9. ALL 1% RESISTERS ARE 1/8W.
8. W4 IS NORMALLY OMITTED. SEE INSTRUCTION MANUAL FOR USE
7. ALL POTENTIOMETERS ARE 1W, 5%
6. W1 & W2 ARE FACTORY SELECT
5. ALL FETS ARE E175
4. * DENOTES FACTORY SELECT
3. ALL DIODES ARE IN4148
2. ALL CAPACITORS ARE IN MICROFARADS
1. ALL RESISTORS ARE IN OHMS, 1/4W, 5%
NOTES: UNLESS OTHERWISE SPECIFIED

Figure 10-1. Schematic Diagram Master Board, A1
Dwg No. 4-501580-001 (A) (Sheet 1 of 2)

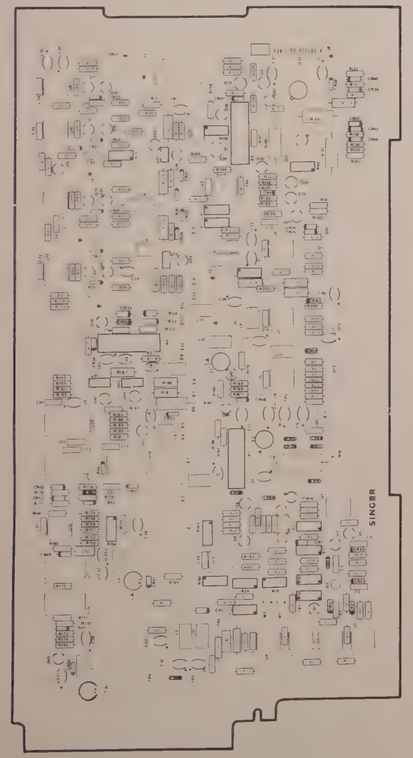
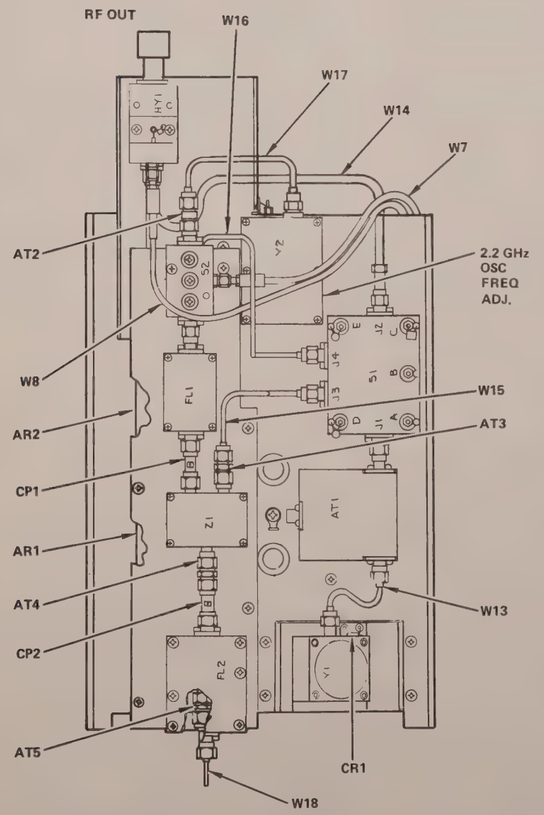


Figure 10-1. Schematic Diagram Master Board, A1
Dwg No. 4-501580-001 (A) (Sheet 2 of 2)



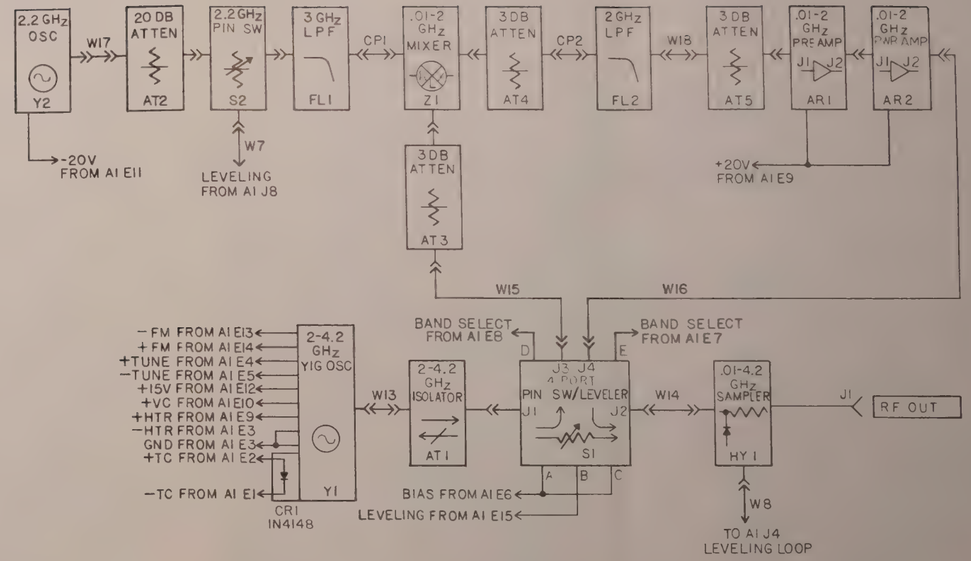


Figure 10-2. Schematic Diagram RF Deck, A2 DWG No. 3-501579-001 (A)

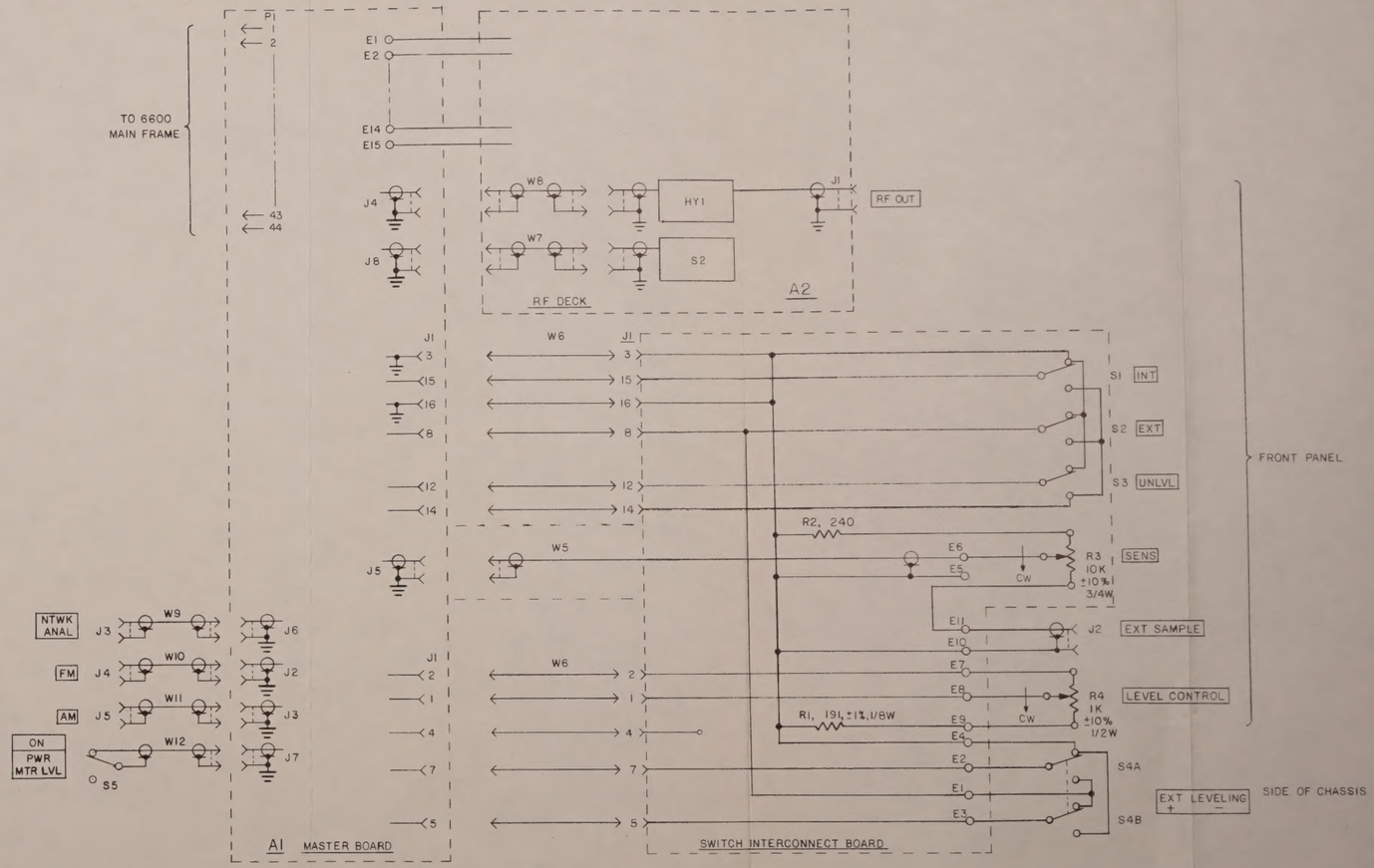


Figure 10-3. Schematic Diagram Front & Rear Panel and Interconnect Board, A3
Dwg No. 4-501582-001 (A)

MP MASTER
MA35199

92788